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EARLY TRAINING ESTIMATION SYSTEM (ETES)
FINAL REPORT
APPENDIX F: USER'S GUIDE

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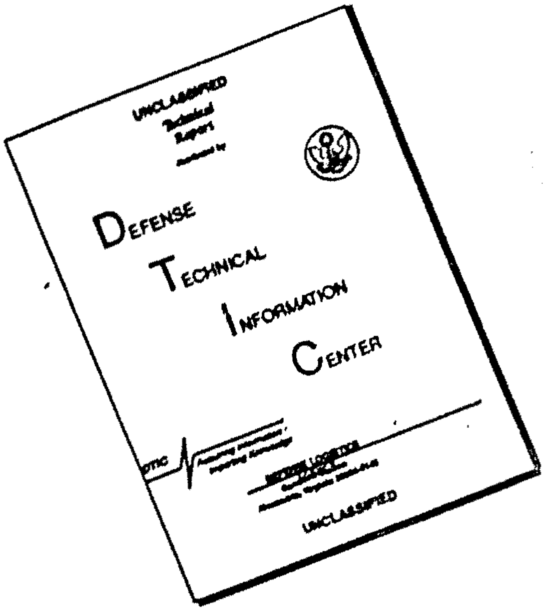

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This report describes the research and development activities conducted under the Early Training Estimation System (ETES) development project. The Early Training Estimation System (ETES) is an integrated set of procedures and automated tools for estimating training requirements during the earliest phases of the weapon system acquisition process. The ETES has three major components; a System Description Technology (SDT), Early Training Estimation Aids and Procedures (TEAP), and Evaluative Technology. The SDT is a data base management system for storing and tracking task and training-related

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PREFACE

This user's guide is part of the Early Training Estimation System (ETES). Development of the ETES was sponsored by the Army Research Institute (ARI) under contract No. MDA-903-80-C-0525. Dynamics Research Corporation (DRC) of Wilmington, Massachusetts was the contractor. The contract monitor for the project was Dr. Charles Jorgensen. The guide was written by Dr. Lawrence O'Brien, Dr. Michael Wagner, and Ms. Beth Modica.

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SECTION I - INTRODUCTION AND SUMMARY

I.1 OBJECTIVES

This guide describes the manual procedures in the Early Training Estimation System (ETES). The objective of ETES is to provide an integrated set of procedures and automated tools for estimating training requirements for emerging Army weapons systems during the earliest phases of the acquisition process (Mission Area Analysis, Concept Exploration, and Demonstration and Validation).

Detailed descriptions of ETES automated tools are available in the following documents:[1]

- User's Guide: ETES System Description Technology (approximately 300 pages)
- User's Guide: ETES Media Selection Program (approximately 200 pages)
- User's Guide: ETES Resource and Cost Estimation Technique (approximately 100 pages)
- User's Guide: ETES Automated Training, Planning and Scheduling Technique (approximately 100 pages)

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[1] For information on obtaining ETES documents, contact Dr. Lawrence O'Brien, Dynamics Research Corporation, 7 Lopez Road, Wilmington, MA 01887.

A description of the research which led to the development of ETES is provided in the ETES Final Report. Additional descriptions of ETES tools are provided in the following technical papers:

Jorgensen, C., and O'Brien, L. The Early Training Estimation System: An automated training needs assessment technique. (Paper to be published in the first issue of the Training Technology Journal).

O'Brien, L. Automated System Description Technology. Paper presented at the Second Annual Conference on Microcomputers in Education, Washington, June 1982.

Boylston, D. An automated decision aid for the assignment of tasks to training media in early training estimation. Paper to be presented at the 51st Symposium of the Military Operations Research Society, September 27-29, 1983.

O'Brien, L. Early Training Estimation System (ETES). Proceedings of the TRADOC Developments Institute Chiefs of Analysis Seminar, October 21-13, 1981.

I.2 ORGANIZATION

The remainder of this section describes (a) the requirements which led to the development of ETES, (b) the intended users of ETES, (c) the components of ETES, (d) key concepts underlying the ETES procedures, and (e) guidelines for managing an ETES application.

Sections 1 thru 6 describe the ETES Training Estimation Aids and Procedures. Sections 7 and 8 describe the procedures in the ETES Evaluative Technology.

Overviews of the three ETES Automated Training Estimation Tools -- the Media Selection Program, the Resource and Cost Estimation Technique (RCET), and the Automated Planning and Scheduling Technique are provided in Appendices A, B, and C, respectively. An overview of other Army Research Institute projects related to ETES is provided in Appendix D. A data source index describing the most common data sources which are used in an ETES application is provided in Appendix E.

I.3 NEED FOR EARLY TRAINING ESTIMATION

The Early Training Estimation System provides a capability for systematically estimating training requirements for developing Army weapon systems during the earliest phases of the acquisition process (Mission Area Analysts, Concept Exploration - Phase I, and Demonstration and Validation - Phase II). These estimates of training requirements include specification of the system's task requirements, training course requirements, resource requirements, and estimates of training cost and "effectiveness."[2]

There are two major reasons why early estimates of training requirements are needed. First, by developing earlier and more accurate estimates of training requirements, the training planning process can begin earlier. As a result, the training products associated with a system, many of which require a long lead time, are more likely to be available when the system is fielded.

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2 ETES only provides gross high level estimates of training effectiveness. These estimates are only appropriate during the earliest phases of the acquisition process.

Second, by developing estimates of training requirements for the various design alternatives which are considered during early phases of the acquisition process, the training developer can provide the information needed to effectively influence system design.

The importance of obtaining training projections during the earliest phases of system acquisition cannot be over-estimated. Most of the major design decisions related to a new system are made during the early phases of the acquisition process (see Figure I-1). Thus, if training is to influence design, it must impact these early design decisions. And there is good reason for ensuring that training-related considerations do, in fact, impact design.

In most weapon systems, manpower costs, including training costs, are the largest component of the system's operation and support costs. Because these costs are the result of demands generated by the design characteristics of a system, acquisition policies have been established by the Federal Government to ensure that support requirements are accurately determined and evaluated in conjunction with system development (for example, the DoDD 5000 series on major systems acquisition). ETES is specifically designed to provide the Army with the capability for meeting the training-related requirements specified in these acquisition policies.

I.4 INTENDED USER OF ETES

As part of the review of existing Army procedures conducted during Task 1 of the ETES development study, potential users

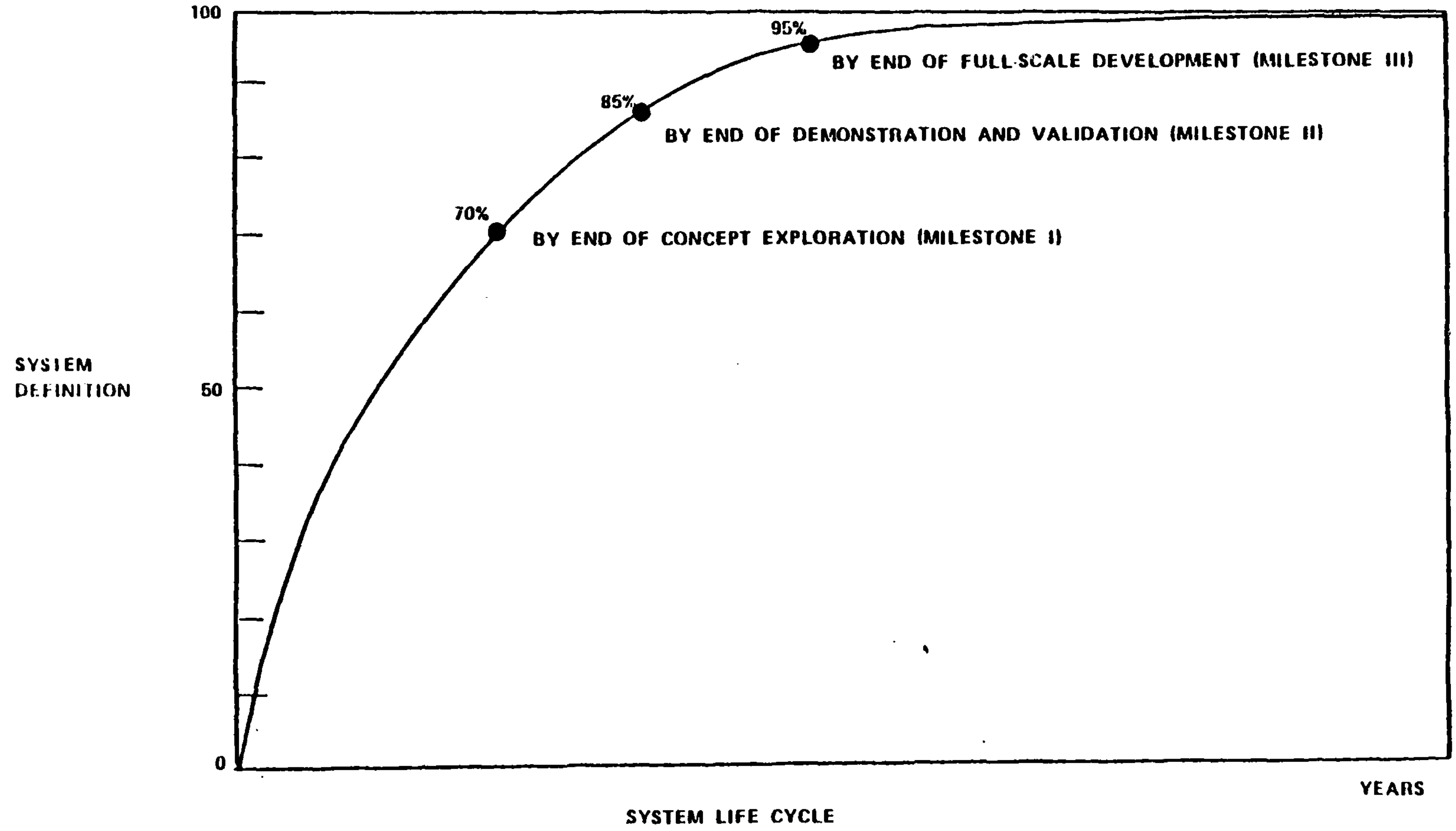

Figure I-1. System Definition as a Function of Acquisition Phase.

for an early training estimation system were identified. The primary user organizations of ETES are expected to be (1) the training developers in the Army schools associated with the development of new systems, (2) program management offices (PMOs) for new systems, particularly those individuals concerned with training development or Integrated Logistics Support, (3) the TRADOC System Manager (TSM), (4) other Army organizations concerned with training development such as the TRADOC System Analysis Activity (TRASANA) and PM TRADE, and (5) contractors who must develop training requirements for new systems.

I.5 ETES COMPONENTS

ETES has three major components; a System Description Technology (SDT), Early Training Estimation Aids and Procedures (TEAP), and Evaluative Technology (see Figure I-2). The SDT is a data base management system for storing and tracking task and training-related data. The data in the SDT is used in the TEAP to estimate training requirements for a new system. These training requirements include estimates of task requirements, course requirements, and resource requirements as well as estimates of training costs, training efficiency, and training "effectiveness". In the Evaluative Technology component, the integrated impacts of training requirements are assessed, training alternatives are evaluated, tradeoffs and sensitivity analyses of key parameters are conducted, and the relationships between ETES outputs and key Army acquisition documents and processes are specified.

More details on the three components of ETES are provided in the sections which follow. A detailed description of the

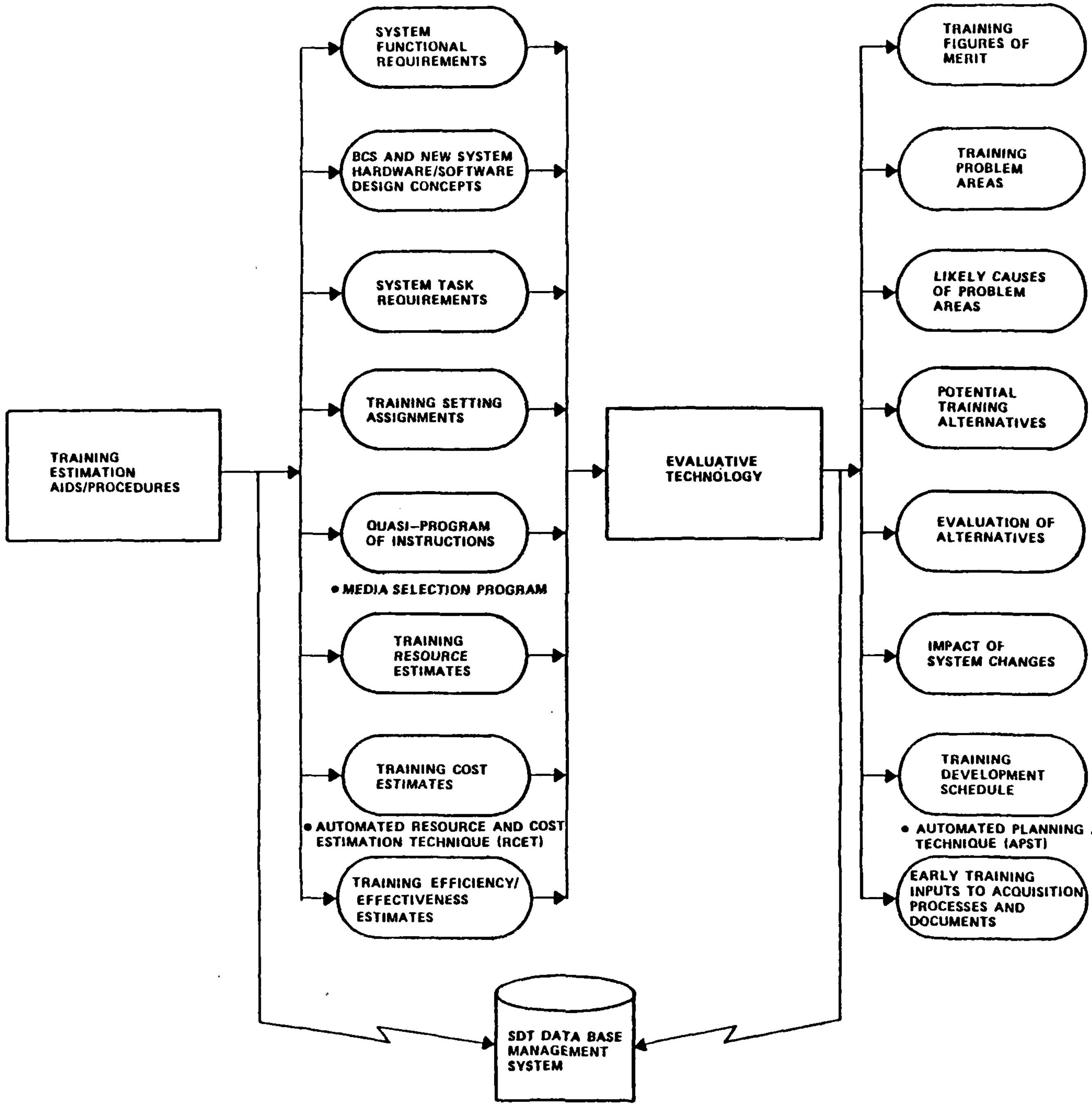

Figure I-2. ETES Components.

SDT is provided in User's Guide: ETES SDT. Detailed descriptions of the Training Estimation Aids and Procedures are provided in Sections 1 thru 6 of this guide. Detailed descriptions of the Evaluative Technology are provided in Sections 7 and 8 of this guide.

There are three automated aids associated with the Training Estimation Aids/Procedures and Evaluative Technology; (1) the Media Selection Program which is an automated tool for assigning tasks to media, (2) the Resource and Cost Estimation Technique which is an automated tool for estimating instructor requirements and course costs, and (3) the Automated Planning and Scheduling Technique (APST) which is an automated tool for describing and monitoring the training development schedule. Detailed descriptions of these three automated tools are provided in User's Guide: Media Selection Program; User's Guide: Resource and Cost Estimation Technique; and User's Guide: Automated Planning and Scheduling Technique.

I.5.1 The SDT

The SDT is a microcomputer-based data base management system for (1) describing actual and projected system elements including system functional requirements, system hardware and software concepts, tasks, skills, and training program elements and their associated resource and cost requirements, (2) for storing the above information, (3) for changing and updating this information, and (4) for transmitting the information among the participants in the acquisition process. The SDT data base management system is designed to allow training developers to keep track of the numerous system changes which occur during the early phases

Table I-1 SDT Data Elements

FUNCTIONAL REQUIREMENTS	EQUIPMENTS	DUTY POSITIONS	MISSIONS
• SYSTEM PERFORMANCE MEASURES • ENVIRONMENTAL IMPACTS • THREAT IMPACTS • FUNCTION SEQUENCE INFORMATION	• EQUIPMENT BREAKDOWN STRUCTURE • GENERIC FAMILY RELIABILITY DATA • NUMBER SUPPORTED AT EACH MAINTENANCE LEVEL • EQUIPMENT COSTS • SYSTEM INFORMATION FLOW • SOFTWARE REQUIREMENTS	• OCCUPATIONAL SPECIALTIES • MANPOWER REQUIREMENTS (BY YEAR) • SALARY REQUIREMENTS • LOCATION IN ORGANIZATIONAL STRUCTURE	• PERCENT OPERATING TIME • ANNUAL NUMBER • ANNUAL OPERATING DAYS
TASKS	**COURSES**	**MEDIA**	
• TASK ELEMENT • TASK CONDITION • TASK STANDARD • INITIATING CUES • TERMINATING CUES • TOOLS/TEST EQUIPMENT • FAILURE MODES • LEARNING OBJECTIVES • PERFORMANCE MEASURES • SKILLS AND KNOWLEDGES • TRAINING EMPHASIS SCALES	• PREREQUISITE COURSES • FOLLOW–ON COURSES • COURSE COSTS • STUDENT INPUT REQUIREMENTS(BY YEAR) • MODULES –*METHODS* –STUDENT/INSTRUCTOR RATIOS	• COSTS • ISSUE RATE • TYPE OF MEDIA • TRAINING ASSIGNMENTS	

of the acquisition process. In addition, it provides a centralized data base, thus eliminating the redundant data collection efforts which typically take place among the numerous training development organizations within the Army.

The computerized SDT also facilitates the use of automated aids for estimating training program elements and their associated resource and cost requirements. These automated aids allow the training developer to quickly develop training requirements estimates for alternative training and system concepts. This capability greatly increases the probability that training requirements will be effectively considered during the early phases of the weapon system development process.

I.5.1.1 SDT Data Elements

To provide an effective communication vehicle for training developers and other participants in the acquisition process, the SDT has been designed to describe (a) training programs and their associated resources, (b) the tasks which drive these training programs, (c) the personnel who will be required to perform the tasks, (d) the system designs which generate the task requirements, and (e) the functional requirements for which the system designs have been developed. An overview of the major data elements currently included in the SDT is provided in Table I-1. Although the data elements in the SDT are designed to remain fixed for any particular application, <u>the SDT software allows the SDT data base manager to quickly change the data elements to meet the needs of particular users and/or models</u>.

I.5.1.2 Characteristics of SDT Data Base

Data base management systems such as the SDT use a specialized "language" to describe the relationships among data elements. Unlike many other data base management systems, the SDT does not require the user to explicitly use or even know about this specialized data language. In the SDT, the data language is made "invisible" to the user through "user-friendly" human-computer dialogue techniques such as menu selection and question-and answering.

There are four major types of variables in the SDT data language:

- o Entities - Major system elements. Entities are roughly equivalent to nouns in the English language. The entities in the SDT are functional requirements, system missions, equipment, tasks, courses, training media, and personnel.

- o Subentities - Lower level system elements. Subentities are linked to entities in a hierarchical fashion. For example, "task conditions" are subentities of "tasks".

- o Attributes - Descriptors that delimit or specify important properties of entities. Each attribute has a set of values associated with it. Attributes are used to describe both entities and subentities. For example, one attribute for the entity task is "task frequency."

- Pointer Variables - Variables used to specify the relationship which exist between different entities, between entities and subentities and between entities, subentities, and attributes. The relationships specified by the pointer variables determine the SDT data structure. (The SDT uses elements of both hierarchical and relational data base structures.)

I.5.1.3 SDT Configuration

When fully implemented, the SDT will utilize a distributed processing architecture (see Figure I-3). A centralized data base for each weapon system (or weapon system alternative) will be stored on a mainframe computer. At periodic intervals, users will transfer a copy of the data base from the mainframe to a local microcomputer. Once on the micro, users can perform standard data base management functions (input, output, modify). Thus, all major data base management functions can be performed independently. Once users have completed their activities, they can transfer the updated version to the mainframe. A detailed "audit trail" will be kept for each weapon system so that users can systematically track and assess system changes. The current version of the SDT is designed to operate on (1) an APPLE III microcomputer with a modem, printer, monitor, floppy disk drive, and a 5 megabyte hard disk and (2) a Honeywell DPS 8/32 mainframe computer. The mainframe computer is actually only needed when there is more than one user and these users are located at several different sites. The SDT has built-in security features which allow the SDT manager to restrict data input, modify, and output capabilities to a limited set of users.

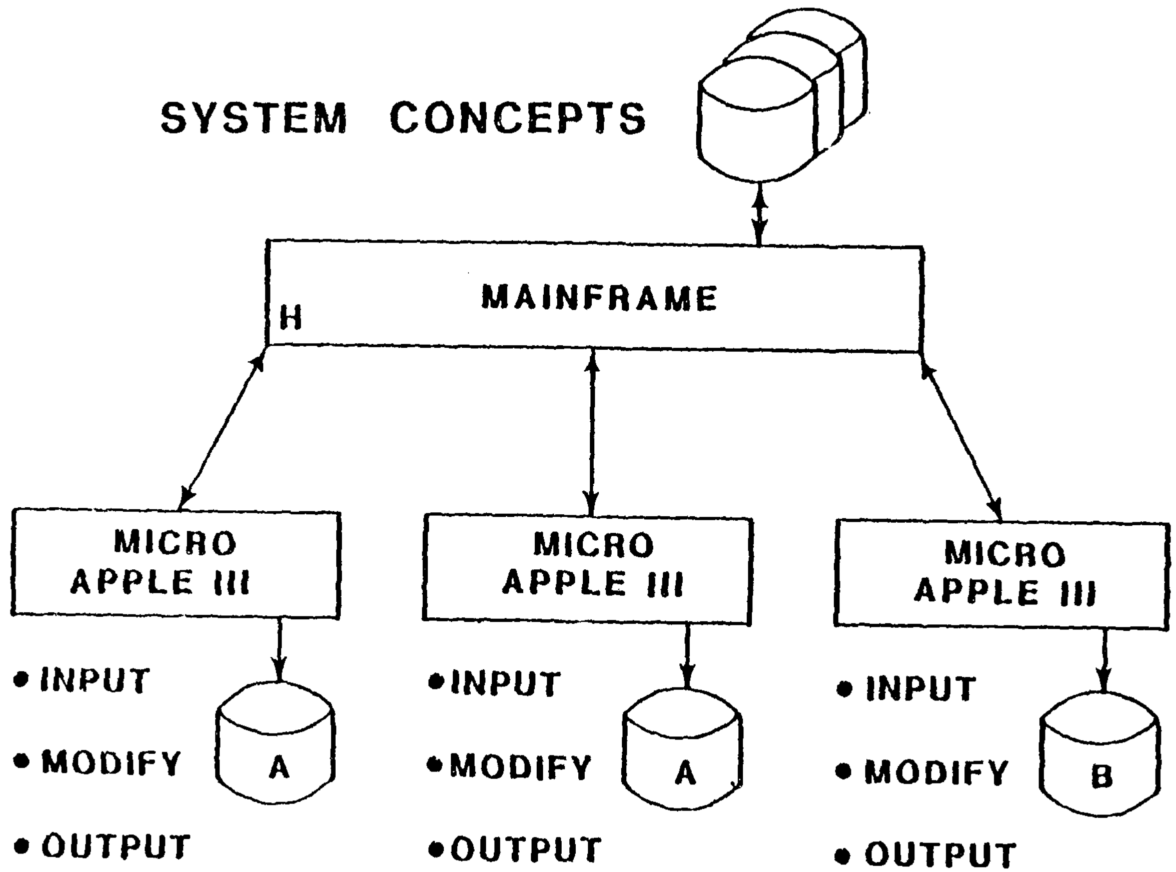

Figure I-3. ETES Architecture.

I.5.1.4 SDT Operation

To provide a user-friendly interface, dialogue on the micro computer relies on menu selection techniques for data item and command selection and data output. Form-filling and question and answer dialogue techniques are used for data input. A "help" key is provided to allow users to obtain guidance on all SDT commands and data elements. This "help" capability can be activated at any time during the operation of the SDT by pressing the Escape key on the APPLE keyboard.

I.5.1.5 Generation of Data for SDT

In order to provide a capability for early training requirements estimation, the SDT will be used to describe system elements during the earliest phases of the acquisition process. To generate data during these early phases, comparability analysis procedures, which are part of the ETES Training Estimation Aids/Procedures, will be employed.

During the early phases of the system acquisition, when only information on a system's functional requirements is available, comparability analysis techniques will be used to identify existing subsystems which are similar to those of the new system. Historical data for these subsystems will then be collected and modified to (1) meet the differential characteristics of the new system and (2) correct any inherent deficiencies in the historical data base. By utilizing design and task data from comparable, existing systems, meaningful early estimates of training requirements can be made when only functional information on the projected system is available (see Figure 1-4). Later, as

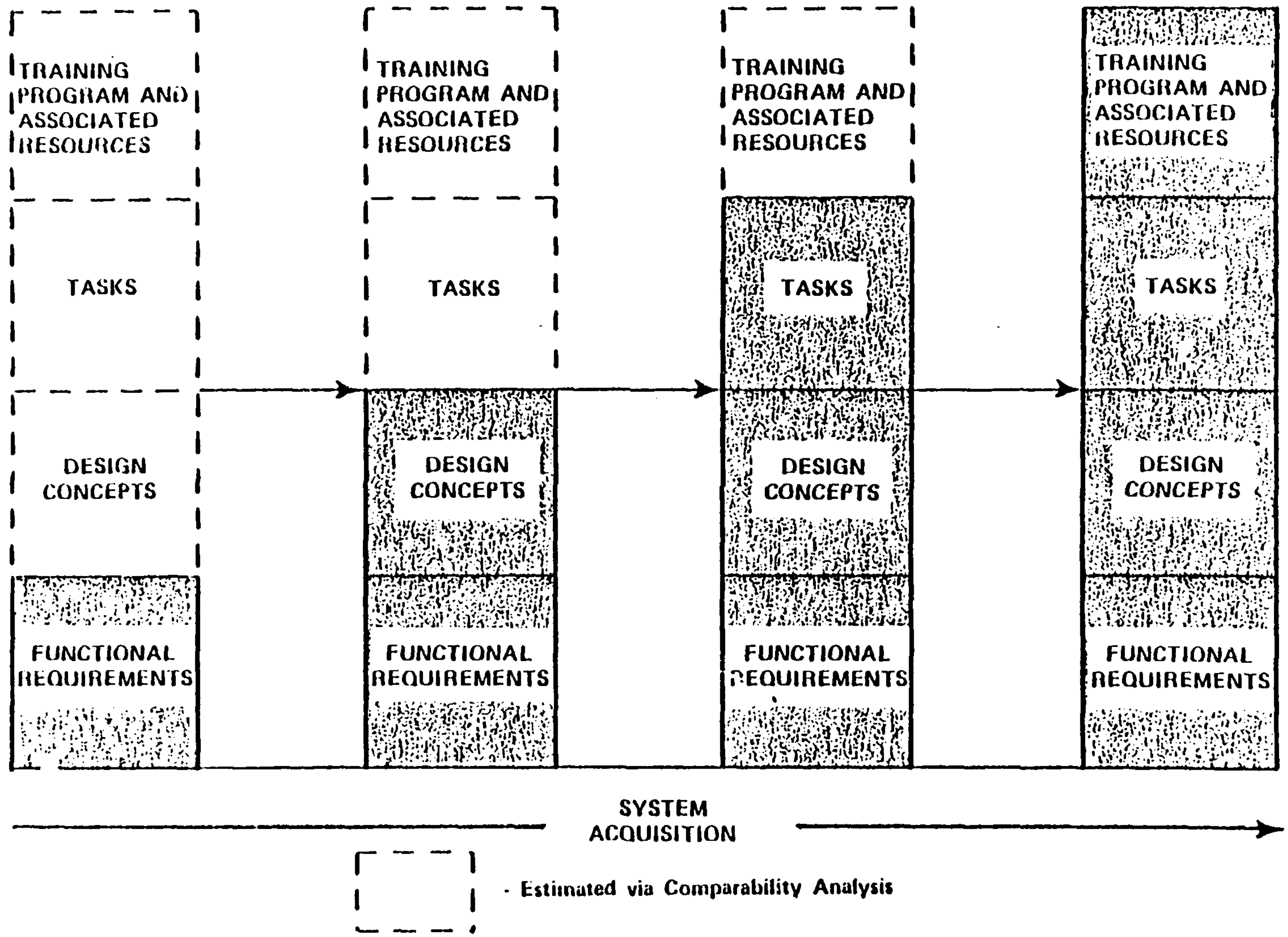

Figure I-4. System Development Process for SDT.

actual design concepts are developed, comparability analysis can be used to develop estimates of tasks and training program elements. Still later, when the actual system tasks are available, only the training program elements must be estimated.

Thus, by adding comparability analysis procedures to SDT data base management capabilities, the SDT will be capable of (1) describing alternative system concepts during the earliest phases of the acquisition process, (2) describing projected system elements, (3) relating alternative system concepts to a common framework so that meaningful comparisons can be made, and (4) refining system information as more accurate and more detailed data are developed.

I.5.1.6 Application of SDT in the System Acquisition Process

In its initial application to a particular weapon system development process, the SDT can be used to describe the system functional requirements which are generated during functional analysis. These requirements specify the functions which must be performed if the system is to satisfy its designated mission need. The SDT can be employed in a functional analysis as soon as the need for a particular system has been specified. Formally, this activity occurs after the approval of the requirements document at Milestone 0, which initiates the Conceptual phase of the acquisition process. However, the SDT could probably be used to describe functional requirements even prior to Milestone 0 if alternative system concepts were identified earlier.

Once the functional requirements for a system have been developed and described via the SDT, the SDT can be used to generate and describe system designs. These designs specify possible mechanisms for performing the desired functions. These mechanisms include equipment, personnel, and software. Once developed, the system designs can also be described with the SDT.

Once the mechanisms for accomplishing the functions have been identified in the design concepts, the human tasks which must be performed to utilize the system designs can be specified. These tasks, which are the key building blocks of training development, can be documented in the SDT. After the tasks are identified and specified in the SDT, training estimation aids and procedures can be used to determine training program elements, estimate training resources, and develop training products. The resulting training program and its associated resources can then be documented in the SDT.

The SDT, like the other components of ETES, is primarily designed for applications during the Concept Exploration phase of the acquisition process, which runs from Milestone 0 to Milestone 1. However, the ETES can also be used during subsequent phases of the acquisition process. The primary uses of ETES during these later phases are to (1) make more detailed estimates of task and training resource requirements, (2) determine the impact of subsequent design changes on task and training requirements via the data base management capabilities of the SDT, and (3) conduct trade-off studies of proposed solutions to identified training problems.

I.5.2 Training Estimation Aids/Procedures (TEAP)

The Training Estimations Aids/Procedures are an integrated set of procedures and automated aids for performing six key early training estimation functions: (1) Functional Requirements Analysis - Systematic description of the functions which the system must perform and, where necessary, estimation of the hardware/software design concepts needed to achieve these functions, (2) Task Generation - identification of the tasks required to operate or maintain the system, (3) Training Program Estimation - estimation of where and how the tasks should be trained, (4) Training Resource Estimation - estimation of the training resources needed to implement the training program, (5) Training Cost Estimation, and (6) Training Efficiency/"Effectiveness" Estimation - estimation of the adequacy with which the training program can be expected to train personnel.

A listing of the ETES Training Estimation Aids and procedures is contained in Figure I-5.

The TEAP includes new techniques as well as existing methodologies from other ARI research projects such as the Training Efficiency Estimation Model (Jorgensen, Kubala, and Atlas, 1981), recent work on cost and training effectiveness analysis by Dawdy, Chapman, and Frederickson (1981), and the Hardware/Procurement - Military Manpower (HARDMAN) methodology (O'Brien, 1983; Mannle, 1981). These existing methodologies were modified to meet the specific requirements of early training estimation. Brief descriptions of the Training Estimation Aids and Procedures follow.

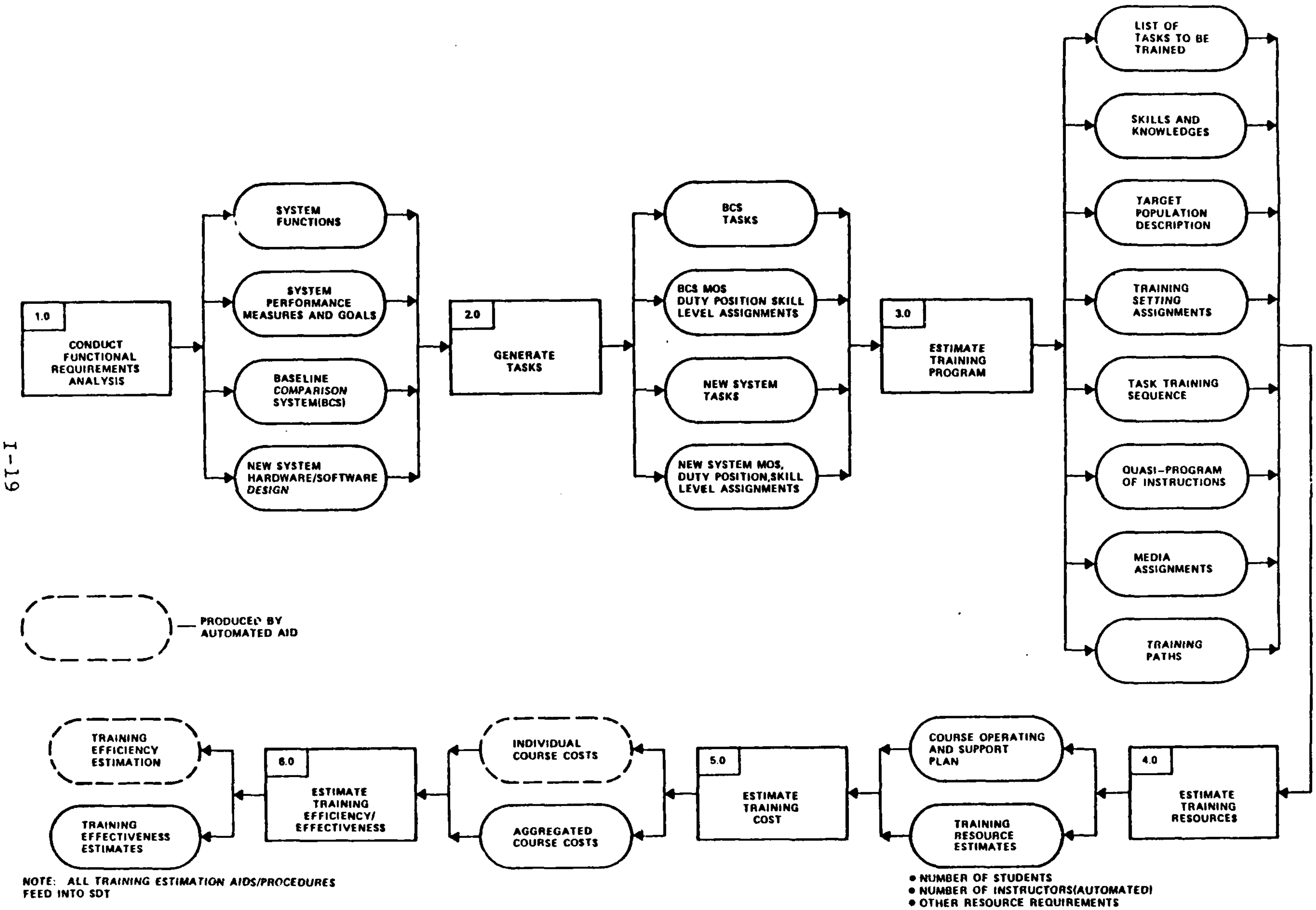

Figure I-5. ETES Training Estimation Aids/Procedures.

I.5.2.1 Functional Requirements Analysis

In order to estimate training requirements for a new system, the training developer must have information on the system's hardware/software design, and its functional requirements. Unfortunately, this information is often not available to training analysts during the early phases of the acquisition process. Consequently, it is often the case that no systematic estimates of training requirements are developed during these phases. The TEAP is designed to assist the training analyst in overcoming these problems by providing systematic techniques for estimating the system's functional requirements and hardware/software design during the early phases of system acquisition. The TEAP procedures for estimating system functions, and hardware/software design are at a general level. They are designed to provide the minimum amount of information needed for early training estimation. As the development of the system progresses, and actual information on system functional requirements and hardware/software design are developed, these system elements no longer need to be estimated by ETES procedures but can be obtained directly from the combat developer (functional requirements) or materiel developer (hardware/software design and manpower requirements).

ETES functional requirements analysis procedures provide a description of the information which should be generated during the functional requirements analysis and the steps that one must go through to generate these elements.

Early estimates of system hardware/software design are generated via comparability analysis. Quite simply, comparability analysis involves (1) identifying comparable

existing systems, (2) collecting data on the comparable systems, and (3) modifying these data to reflect the differences between the comparable existing system(s) and the new system.

The most recent version of the DoD standard on Logistics Support Analysis (LSA) (MIL-STD-1388) identifies comparability analysis as the preferred method for estimating key system elements during the early phases of the acquisition process.

Identification of comparable equipment in ETES takes place in three major phases: (1) identification of the Predecessor equipment system(s), (2) identification of the Baseline Comparison System equipment system, and (3) identification of the New equipment system.[3] The BCS is constructed by (a) adding subsystems to the Predecessor subsystem to reflect additional capabilities required in the New system (i.e., the system under development), and (b) subtracting subsystems to reflect capabilities no longer required in the New system. The BCS provides a baseline for comparing the New system training requirements to other similar systems. The BCS concept is directly congruent with the new version of MIL-STD-1388 which specifically calls for the construction of a BCS during the early phases of the acquisition process.

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[3] The procedures described in this section were derived from the HARDMAN Methodology. A description of the HARDMAN Methodology is presented in Appendix D.

I.5.2.2 Task Generation Procedures

In the present version of ETES, comparability analysis is used as the principal means of estimating task requirements. In this approach, task data for the comparable existing system(s) are collected and modified to reflect the differences in design and/or employment between the New and comparable system.

The task generation process begins with the collection of task data for the equipments and MOSs in the BCS system. The BCS is composed of the existing subsystems (including the Predecessor subsystems) which come closest to meeting the New system functional requirements. The primary data source for existing task data is the Soldier's Manual since it, by definition, contains all tasks associated with an MOS. The task data from existing systems are updated to reflect any equipment or doctrinal changes that were made since the source was published.

Once the BCS task data has been collected and updated, this data is examined and compared to the New system hardware/software design and functional requirements. BCS tasks associated with equipments or functions which are no longer needed are eliminated. New tasks are added to reflect new equipment or functions. Descriptions of new tasks are developed in accordance with existing Instructional Systems Development (ISD) guidelines.

Identification of New system operator tasks is facilitated by examining the subsystem functions identified during the functional requirements analysis.

By adding and deleting BCS tasks, a New system task list can be constructed. The reason for each deletion/addition is documented using a systematic set of modification codes.

It is possible that a New subsystem may require the same task as a BCS subsystem but that the essential characteristics of this task must be changed to reflect the New system requirements. For example, the same task may be required for both the BCS and New system but the frequency with which the task is performed may differ.

To account for these changes to essential task characteristics, all tasks with major modifications are identified and the reason for each task modification is documented.

Once tasks have been identified, their conditions and standards can be developed using existing ISD procedures. These same procedures are used to assess the adequacy of any new task descriptions which are generated during comparability analysis.

I.5.2.3 Training Program Estimation[4]

Algorithms are provided to assist the training analyst in determining the tasks to be trained and assigning these tasks to training settings. To provide input to these algorithms, tasks are rated on a series of task characteristics (e.g., frequency, learning difficulty). Several different algorithms are provided to meet the needs of different phases of the acquisition process.

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[4] The current version of ETES only contains procedures for estimating training programs for individual institutional training courses.

Quasi-programs of instruction (QPOI) are constructed by (1) modifying or deleting modules from existing courses to reflect the task deletions and modifications made during task generation and (2) adding modules to reflect the unique requirements of the New system. As part of the QPOI construction process, the instructional methods and curriculum hours which must be devoted to each module are determined.

Media for the training program are selected by the application of an automated aid, the Media Selection and Efficiency Estimation Program. This program is an extension of the Training Efficiency Estimation Model (TEEM) produced by Jorgensen et al. (1981). The Media Selection and Efficiency Estimation Program significantly expands the capabilities of TEEM by recasting media selection as a dynamic programming problem and automating these procedures on the Apple III microcomputer. This automated program permits the user to employ the SDT to input and store the data needed to feed the media selection procedures. Using dynamic programming techniques, the program can assign tasks to media in a manner that optimizes efficiency, relative cost, or efficiency and relative cost.

Efficiency is determined by comparing the stimulus, response, and feedback characteristics of the individual task to the stimulus, response, and feedback characteristics of potential media categories. More specifically, a score is calculated which describes the match between media and task characteristics. Efficiency for each task-media combination is calculated by dividing this score by the maximum match that may be achieved for the task.

Total efficiency for a set of tasks is determined by aggregating the efficiency score for individual tasks. An additional efficiency measure can be calculated by weighting the efficiency of each task by the task criticality score. This task criticality score is calculated by aggregating the task factors typically used in selecting tasks for training (e.g., task frequency, percent members performing, task delay tolerance, etc.).

I.5.2.4 Estimation of Training Resources

These procedures estimate the training resources needed to implement the training program. The training resources encompassed by these procedures include (a) the number of students to be trained, (b) number of instructors and support personnel, (c) facilities requirements, (d) training device and training equipment requirements, and (e) ammunition requirements. Included among the procedures are techniques for using off-the-shelf automated worksheet software (e.g., VisiCalc) for storing and applying several of the resource determination algorithms.

I.5.2.5 Estimation of Training Costs

These procedures estimate the costs of the resource requirements and aggregate these costs into a total course cost. The procedures include techniques for using off-the-shelf automated worksheet software to calculate course costs. The procedures also describe how to use modified data from comparable existing courses to assist in the cost estimation process.

I.5.2.6 Training Efficiency/Effectiveness Estimation

Procedures are provided for determining the training efficiency of selected aspects of the training program (e.g., media). Training efficiency is defined as a measure of the extent to which the characteristics of the training program element match the task characteristics of the New system. For example, media training efficiency is determined by comparing the stimulus, response, and feedback characteristics of the tasks to the stimulus, response, and feedback characteristics of potential media categories. An additional variant of this efficiency measure may be obtained by weighting each task by its "criticality" where criticality is determined by aggregating weighted scores of key task characteristics (e.g., frequency, consequences of inadequate performance).

Training "effectiveness" is determined by estimates obtained from subject matter experts. More specifically, a group of subject matter experts is presented with the following information for each task: (a) the target population description of the personnel who will perform the task, (b) a description of the task including its associated conditions, job performance standards, and general skills and knowledges, (c) a description of the training program or training program elements (e.g., course length, methods, media) that will be used to train the task, and (d) the criterion which must be achieved for the task (if different from the job performance measure). Each subject matter expert is then asked to estimate the expected percentage of

soldiers in the target population who will pass the criterion given that training program.[5]

It should be noted that the ETES TEAP is designed to estimate training requirements for a New system. The TEAP is not designed to provide techniques for actually developing instructional materials or programs (e.g., instructor packages, student packages, training literature, training devices). Thus, the TEAP will assist training analysts in determining what instructional materials/programs should be produced, what the content of these materials/programs should be, and in estimating the cost of these materials/programs.

This focus on training requirements estimation rather than on training product development is one of the unique characteristics of the TEAP. This focus on training requirements distinguishes it from other existing training development methodologies such as the Army's Instructional Systems Development (ISD) process and the Army Research Institute's Training Developer's Decision Aid (Hawley, 1979).

The training requirements produced by the TEAP provide front-end information needed for the early planning and analysis of training programs. The training requirements information produced by the TEAP provides the foundation for the actual construction of training products in ISD and

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[5] It is recognized that this measure of effectiveness, may differ from other conceptualizations of training effectiveness. It is also recognized that this approach only provides a gross measure of "effectiveness" that should only be used during the earliest phases of the acquisition process.

other related methodologies. Techniques and methodologies which can be used to develop training products are provided in TRADOC Pam 350-30, Schulz and Farrell (1980), Hawley (1979), and Fink (1981). An overview of the relationship between ISD and ETES is provided in Figure I-6.

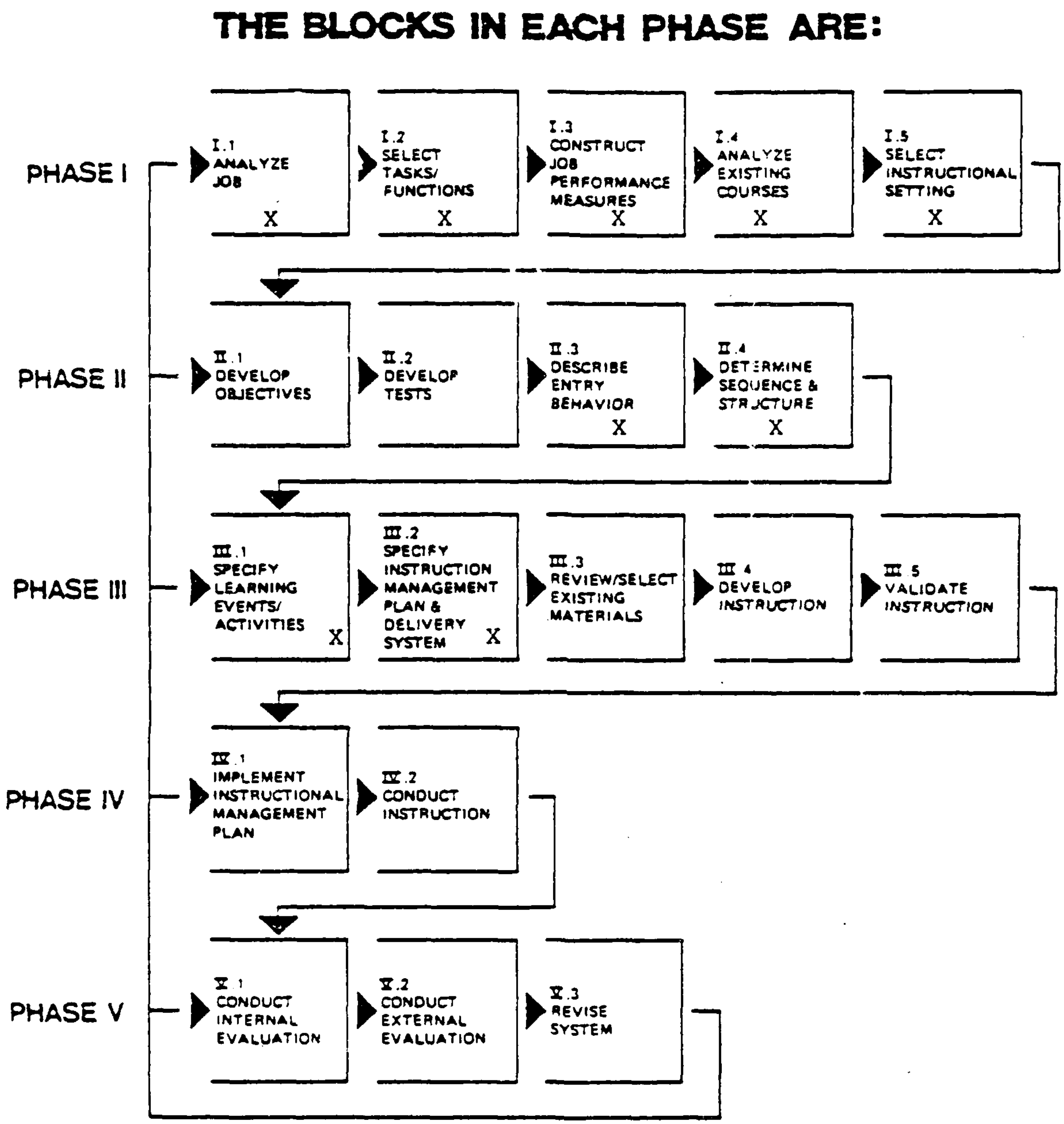
I.5.3 Evaluative Technology

The Evaluative Technology is an integrated set of procedures and automated tools for (1) developing figures-of-merit for assessing the integrated impacts of the training requirements developed in the Training Estimation Aids/Procedures, (2) identifying potential problem areas for system training and the likely sources of these problems, (3) identifying/evaluating training problems, (4) developing training-related input to key acquisition documents, and (5) determining/evaluating training development schedules (see Figure I-7). A summary of the procedures in each of these areas is provided below.

I.5.3.1 Development of Figures-of-Merit

Procedures are included for identifying figures-of-merit which summarize the essential features of the training requirements. Eight potential training figures-of-merit are utilized including (1) cost, (2) training efficiency, (3) training "effectiveness", (4) congruence with training development guidelines, (5) congruence with program requirements, (6) training complexity, (7) feasibility, and (8) summary evaluation score which aggregates the scores on the most critical figures-of-merit (cost effectiveness, and complexity). This summary evaluation score provides a global measure of the "goodness" of a training program.

ISD BLOCKS IN EACH OF THE FIVE ISD PHASES



X = Function Covered by ETES

FIGURE I-6. RELATIONSHIP BETWEEN ISD AND ETES

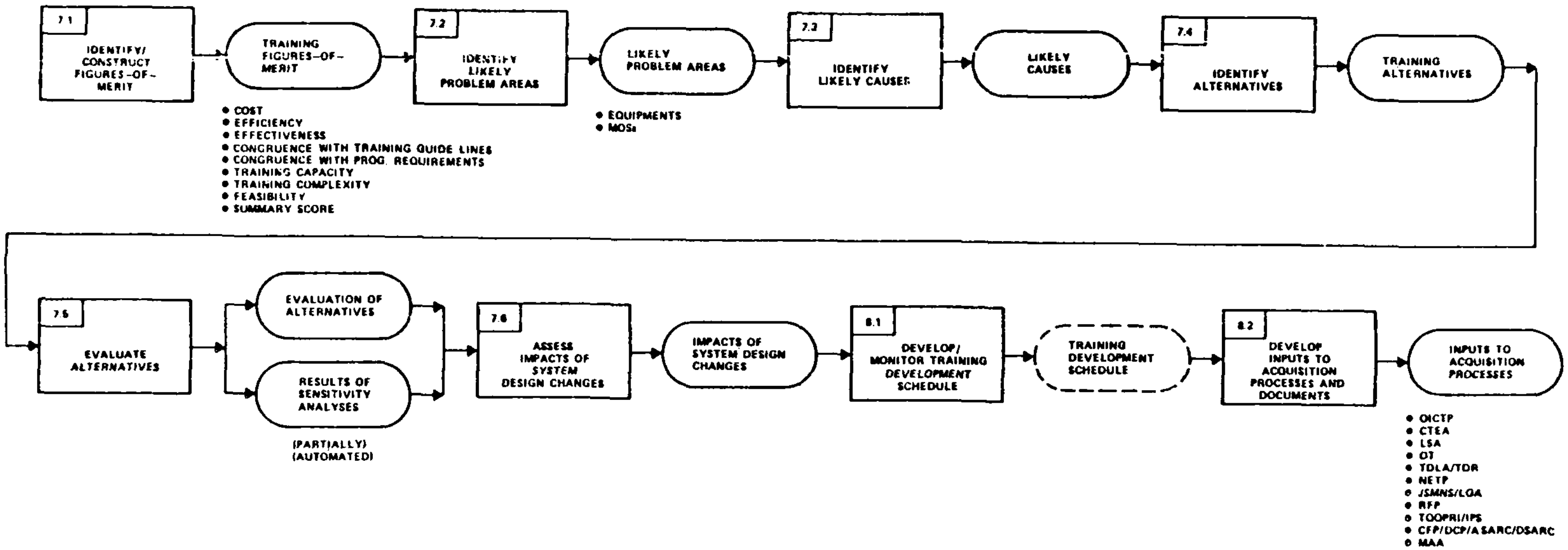


Figure I-7 ETES Evaluative Technology

I.5.3.2 Identification of Problem Areas

Procedures are included for identifying training problem areas. These problem areas consist of the Army Military Occupational Specialties (MOSs) which have high figure-of-merit scores relative to (1) the Predecessor system, and/or (2) the other MOSs in the New system. Procedures are also provided for identifying the courses, equipments, and tasks which contribute to the high figures-of-merit and identifying the training program elements which are likely causes of the high figure-of-merit scores.

I.5.3.3 Identification and Evaluation of Alternatives

Guidelines are included for (1) identifying training alternatives which can address the training problems, (2) evaluating the training alternatives through selected reapplication of TEAP and Evaluative Technology procedures, (3) conducting sensitivity analyses of key parameters, and (4) assessing the impact of non-training system changes (e.g., hardware/software changes) on training.

I.5.3.4 Development and Evaluation of Training Schedules/Plans

Construction of training development schedules for emerging systems is a difficult process. Over 100 developmental events are listed in TRADOC Reg 351-9, the Army regulation governing training plan development. The sequential relationships among these events are complex and are not described in any systematic and integrated manner in TRADOC Reg 351-9. To assist users in developing training schedules, procedures are provided for using automated, off-

the-shelf scheduling software (e.g., VisiSchedule) to track and monitor the training development schedule. By using this software, the training developer can quickly and efficiently respond to changes in the training development schedule. Use of off-the-shelf scheduling software is facilitated by the inclusion of an input data diskette which (a) describes the events in the training development process (as specified in TRADOC Reg 351-9), (2) describes the temporal/sequential relationships among these events and key acquisition milestones, and (3) lists the expected duration of these events for a "typical" major Army weapons system. This data diskette significantly reduces data input requirements. In addition, it eliminates the need for an analysis of the complex sequential relationships among training development events which are either implicitly or explicitly specified in TRADOC 351-9.

I.5.3.5 Develop Inputs to Acquisition Processes and Documents

Procedures are provided for using ETES products to provide inputs to the major Army acquisition processes and documents related to early training estimation. These documents and processes are summarized in Table I-2.

I.6 KEY CONCEPTS UNDERLYING ETES

This section provides a description of several of the key concepts underlying the ETES. Section I.6.1 describes comparability analysis, which is a systematic set of procedures for using data from comparable existing systems to estimate requirements for new systems. Comparability analysis is particularly appropriate during the early phases of the acquisition process.

Table I-2. Major Army Acquisition Processes and Documents Related to Early Training Estimation

- Cost and Training Effectiveness Analysis (CTEA)
- Outline Individual and Collective Training Plan (OICTP/ICTP)
- Logistics Support Analysis (LSA)
- Operational Testing (OT)
- Training Device Requirements, Documents, and Processes
  - Training Device Letter of Agreement (TDLOA)
  - Training Device Requirements (TDR)
  - Training Device Letter Requirement (TDRL)
  - Training Device Study (TDS)
- New Equipment Training
- System Requirements/Documents
  - Justification for Major System New Start (JMSNS)
  - Letter of Agreement (LOA)
- Request for Proposal (RFP) Development/Evaluation
- Personnel Documents/Processes
  - Tentative Quantitative and Qualitative Personnel Requirements Information (TQQPRI)
  - Integrated Personnel Summary (IPS)
- System Level Documents/Processes
  - Concept Formulation Package (CFP)
  - Cost and Operational Effectiveness Analyses (COEA)
  - Tradeoff Determination (TOD)
  - Best Technical Approach (BTA)
  - Decision Coordinating Paper (DCP)
  - Defense System Acquisition Review Council (DSARC)
  - Army System Acquisition Review Council (ASARC)
- Mission Area Analysis

Section I.6 describes the differences between steady state and phased resource requirements estimation. Section I.6.3 describes the limitations of the current ETES.

I.6.1 Comparability Analysis

ETES is designed to determine training requirements during the earliest phases of the acquisition process. However, during these early phases detailed data on system equipment and key training elements (e.g., tasks) are typically unavailable. This poses an initial problem, because without such data, estimates of training requirements cannot be made. To circumvent this problem, comparability analysis can be used to identify these key system elements. Quite simply, comparability analysis involves (1) identifying comparable existing systems, (2) collecting data on the comparable systems, and (3) modifying these data to reflect the differences between the comparable existing system(s) and the New system.

The most recent version of the DoD standard on Logistics Support Analysis (LSA) (MIL-STD-1388) identifies comparability analysis as the preferred method for estimating key system elements during the early phases of the acquisition process.

An overview of the basic process that is employed in comparability analysis procedures is outlined in Figure I-8. The process begins by determining if the necessary system element (e.g., New system equipment configuration, tasks) has already been developed. If this system element does not exist, a comparable existing system element is identified. A comparable existing system element is a system element

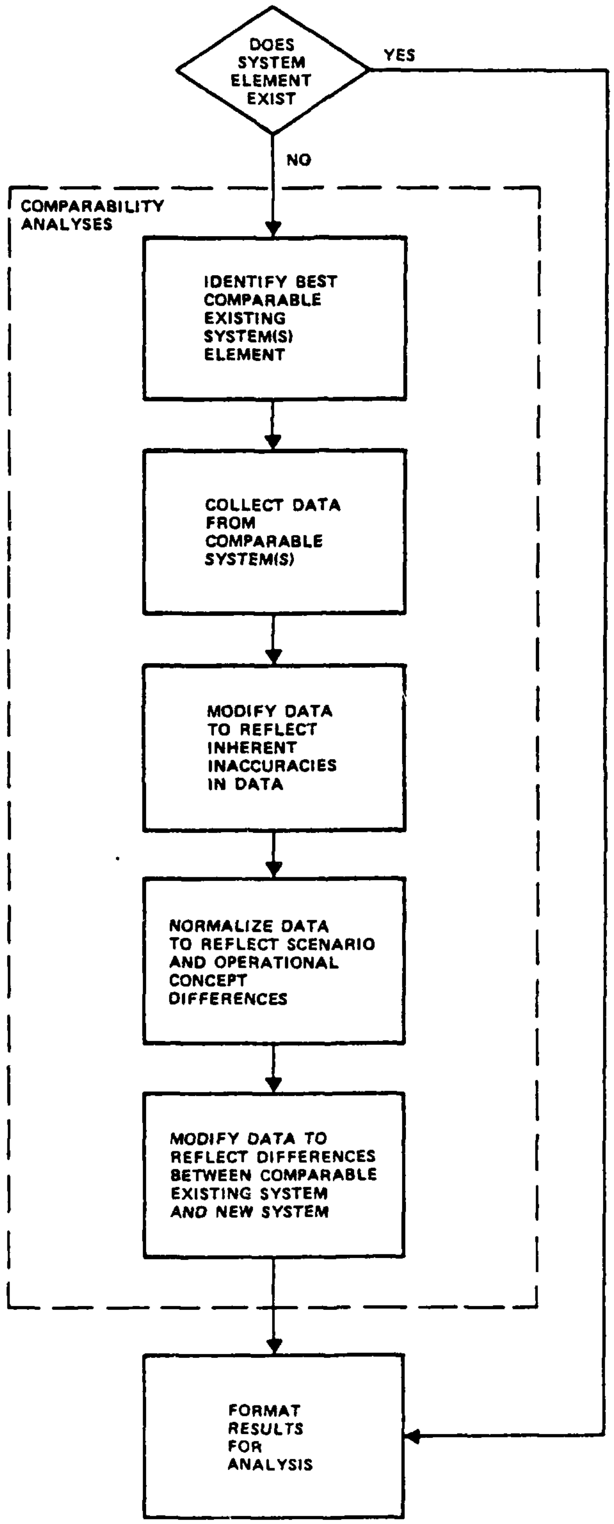


Figure I-8. Overview of Comparability Analysis Procedures.

which performs the same function as the New system element. There may be more than one comparable system element. In these cases, the "best" comparable existing system is selected. The "best" comparable element is the system element which (1) has performance requirements of the New system, (2) has available data, and (3) has been used in an environment which closely matches the scenario, organizational, and operational and support concepts of the proposed New system.

Once the comparable existing system element is identified, the data associated with that element is collected. This data is then modified to reflect any inherent inaccuracies associated with the data base(s) from which the data was collected. The data is also adjusted to reflect differences between the comparable system and the New system in terms of scenarios and operational concepts. In the final step in the comparability analysis process, data on the existing system is modified to reflect the differences between the functional capabilities of the existing system element and the functional requirements of the New system element.

The comparability analysis process outlined in Figure I-8 may be used to identify functional requirements, the system hardware/software design, system manpower requirements, and system task and skill requirements. It may also be used to provide high level estimates of system training program requirements, training resources, and training costs.

The key applications of comparability analysis is in the identification of comparable equipment which occurs in TEAP Function 2.0.

A more detailed description of the procedures used to identify comparable equipment is presented in the subsection which follows.

I.6.1.1 Identification of Comparable Equipment[6]

Identification of comparable equipment takes place in three major phases: (1) identification of the Predecessor equipment system(s), (2) identification of the BCS equipment system, and (3) identification of the New equipment system. The BCS system is constructed by (a) adding subsystems to the Predecessor subsystem to reflect additional capabilities required in the New system (i.e., the system under development), and (b) subtracting subsystems to reflect capabilities no longer required in the New system. The BCS provides a baseline for comparing the New system training requirements to training requirements for other similar systems. The BCS concept is directly congruent with the new version of MIL-STD-1388 which specifically calls for the construction of a BCS during the early phases of the acquisition process.

Predecessor Equipment System(s). The Predecessor equipment system is the system(s) which is currently performing the mission(s) which will eventually be performed by the New system. Thus, the Predecessor equipment system will be replaced by the New system. By definition, the Predecessor equipment is currently in the DoD inventory. In some cases, a Predecessor equipment system may not exist.

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[6] The procedures described in this section were derived from the HARDMAN Methodology. A description of the HARDMAN Methodology is presented in Appendix D.

BCS Equipment System. The BCS equipment system is a notional design composed of the existing subsystems which most closely match the functional requirements of the New system. The BCS equipment system is designed to meet each of the general functional requirements required by the New system. However, since it is composed solely of existing subsystems from the DoD inventory, it will not fully meet all of the performance goals associated with the New system functions.

In order to be selected for the BCS equipment system, a subsystem must meet the following criteria: (1) it must be an existing subsystem currently in the DoD inventory (preferably in the Army inventory), (2) it must be the existing subsystem which most closely meets system performance requirements, and (3) it must have mature task data (the latter set of data is critical for the training requirements determination).

New Equipment System. The new equipment system is an integrated system which is designed to fully meet all system performance requirements. During the early phases of the acquisition process, prior to the receipt of the contractor's design concept, a notional New equipment system is constructed by (1) estimating the new technologies that must be added to their BCS equipment subsystems so that the new system performance requirements can be fully met, and (2) modifying the BCS equipment data to reflect the addition of these technologies.

During the later phases of the acquisition process, the contractor's design(s) can be used as the New system(s). Thus, while there is one BCS equipment system, there may be

several different New equipment systems during the development of any one weapon system.

I.6.1.2 Development of Predecessor, BCS, and New Systems Training Subsystem

Predecessor, BCS, and New training subsystems, (i.e., a system which includes task training programs and training resources and costs) may be constructed to correspond the Predecessor, BCS and New equipment systems. The Predecessor, BCS, and New training subsystems may be defined as follows.

Predecessor System. The predecessor training subsystem is composed of the tasks, and training programs, associated with the predecessor equipment and the training resources and cost associated with these training programs.

Baseline Comparison System (BCS). The BCS training subsystem contains tasks, training programs, and training resources and costs associated with the BCS equipment. Since the BCS equipment subsystems are existing subsystems, the training elements of these subsystems can also be directly obtained from existing data. However, BCS task and training data may be modified to reflect (a) any inherent inaccuracies in the data bases from which it is derived, and (b) differences between the BCS subsystem scenarios and operational concepts and the New system scenarios and operational concepts which may impact task requirements or training resource usage.

New System. The training subsystem for the New system contains the tasks, training programs, and training resources and costs associated with the New system equipment. During the early phases of the acquisition process, New system task requirements are derived by modifying the

BCS task requirements to reflect the design differences between the BCS and New equipment systems. During the later phases of the acquisition process, task data may be supplied by the contractor(s) or cognizant government agencies.

Once task requirements have been determined, it is possible to apply a wide range of analytical techniques to determine the training program requirements and training resources and costs for the New system.

I.6.2 Phased Versus Steady-State Training Resource Requirements

In estimating training resource requirements for a developing system, it is important to distinguish between phased and steady-state resource requirements. Phased resource requirements (e.g., NET resource requirements) are the specific resources that are required while the weapon system is being placed into the inventory, or while the weapon system is being removed from the inventory (the latter case is generally not relevant during system development). Phased resource requirements are displayed by calendar year. In order to determine these phased resource requirements during system development, information on the number of weapon systems introduced into the field in each calendar year must be available and/or estimated.

Steady-state resource requirements are the estimated average yearly resource requirements that are needed to maintain the weapon systems in the field once all of the systems have been fielded. To estimate steady-state resource requirements, all that is required is an estimate of the total number of systems that will be in the field once system

installation has been completed. Steady-state requirements are also presented in yearly units.

ETES provides the capability for estimating both steady-state and phased MPT requirements. This is accomplished by first estimating the steady-state requirements and then modifying these requirements to meet the specific phased requirements that are required to install the system. This approach differs from the usual approach of developing the phased requirements first and then modifying the phased requirements to produce the steady-state requirements. The ETES approach (steady-state, then phased requirements) has an obvious advantage in that it starts with the end objectives (steady-state requirements) and then identifies the intermediate products (phased requirements) needed to meet those objectives.

I.6.3 Limitations of Current ETES

The current version of ETES has the following limitations:[7]

- It does not estimate training programs for individual unit training or collective training.
- It does not estimate acquisition-related training costs.

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[7] These limitations are expected to be addressed in follow-on research conducted by the Army Research Institute. A more detailed description of the limitations of the current version of ETES is provided in the ETES Final Report.

- It provides relatively crude estimates of training effectiveness which are only appropriate for the very earliest phases of the acquisition process.

I.7 GUIDELINES FOR MANAGING ETES APPLICATION

The section describes general guidelines for managing an ETES application. Guidelines are provided in two key areas: data management and study plan construction.

I.7.1 ETES Data Management

To successfully manage the data associated with an application of ETES the user must; (1) track and monitor all input data and data products associated with each ETES procedure, (2) establish and maintain an audit trail of the products produced during each procedure, and (3) store relevant input and output data in the System Description Technology (SDT) data base management system.

An overview of the elements in the ETES data management process is provided in Figure I-9. A more detailed description of these elements is provided below.

Raw Input Data. The raw input data needed to implement ETES procedures may come in a variety of different forms (including hard-copy documents, interviews, magnetic tapes, magnetic discs, and direct on-line data transmissions).

Data Source Index. The data source index is a systematic table describing the source from which each of the raw input data were obtained. The data sources in the data source index are grouped according to major functional

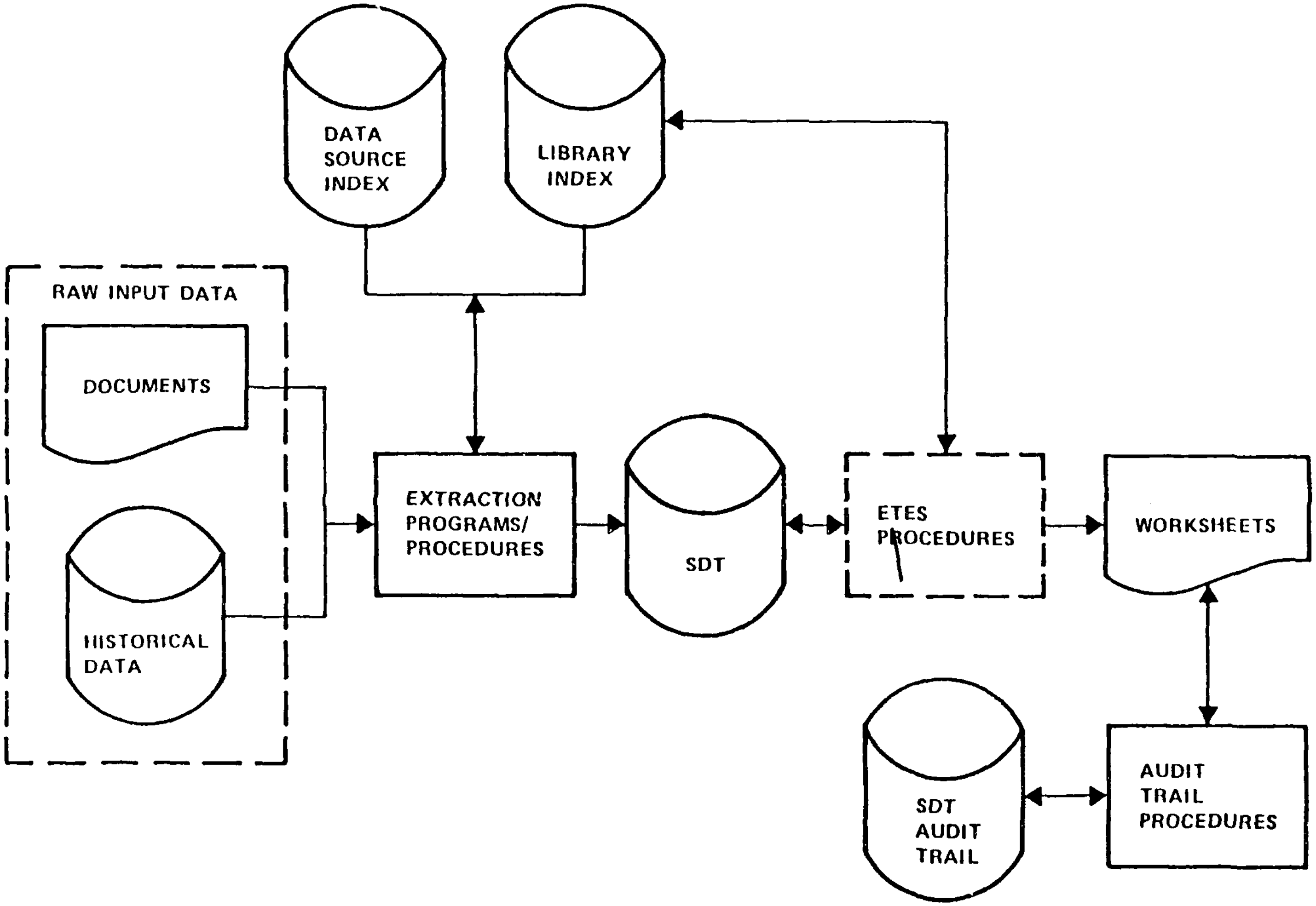

Figure I-9 ETES Data Management

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data categories. An example of a page from a data source index is presented in Table I-3. A complete data source index listing most of the major data sources that will be employed in an ETES application is provided in Appendix F. ETES data is obtained from both system-specific sources (i.e., data bases directly related to the system under investigation) and nonsystem-specific sources (i.e., data bases containing data on a wide range of systems). The data source index can be manual. However, it should be automated to facilitate construction and subsequent update.

Library Index. The library index is a systematic document describing and cataloging (a) each raw input data element and (b) each ETES worksheet. The worksheets describe the intermediate products of ETES analytical procedures. The descriptions in the library index include standard bibliographic information on the input data. They also indicate exactly where the input data or worksheet is currently located (e.g., who has the document, worksheet, etc.). Table I-4 also provides an excerpt from a page in a library index.

Extraction Procedures. The raw data from existing Army data sources may not always be in a form which is appropriate for ETES procedures. In these cases, systematic procedures for extracting the required data elements must be developed as part of the data management process. The specific extraction procedures that are employed will vary depending on the data base and the particular focus of the ETES application. Specific details on data extraction procedures must be obtained from the organization controlling the data base. The organizations associated with the major data sources are listed in Appendix E.

Table I-3. Sample Page From Data Source Index.

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
1. Task Information	Individual Enlisted Tasks Accomplished by MOS/Skill Level	TRADOC Cir 351-28 Soldier's Manuals, Commander's Manuals and Job Books Policy and Procedures	DA Pam 310-3 Index of Doctrinal Training and Organizational Publications	Trainer's Guides (FM's) Soldier's Manuals (FM's)
	Individual Enlisted and Officer Tasks Accomplished by MOS/SSI		None	Training Development Information System (TDIS) (Computer Data Base)
	Individual Tasks Accomplished by Job/Duty Position		Contact: MILPERCEN 325-9272/9493	Comprehensive Occupational Data Analysis Program (CODAP)
	Individual Tasks Accomplished for Operation and Maintenance of Equipment		Contact: ILS Manager for System	Logistics Support Analysis Record (LSAR)
	Collective Tasks	TRADOC Reg 310-2	DA Pam 310-3 Index of Doctrinal Training and Organizational Publications	Army Training and Evaluation Program (ARTEP)

Table I-4. Example Page from Library Index.

Date Entered:	ETES Procedure:
Data Input No.:	Data Output No.:
Worksheet No.:	Responsible Agency:
Reference:	

Document Type:

Journal:	Tape:
Article:	Disc:
Book:	Comp. Cards:
Report:	Direct Comp. Link:
Other–Print:	Other:

SDT. The SDT provides a system-specific data base for describing the basic system elements which are required to apply ETES procedures. The system-specific data base includes both initial input data and output products from ETES procedures, as well as changes to these elements which are made during subsequent applications of the procedures. The SDT contains the key data elements needed to characterize a developing system with an emphasis on the task and training components of the system. The SDT is congruent with the system description provided in the Logistics Support Analysis Record.

Audit Trail Procedures. The ETES audit trail procedures provide a systematic mechanism for (a) tracking the development of training requirements and (b) monitoring changes to the training requirements. The audit trail procedures permit another analyst to replicate and/or validate the study results. The audit trail procedures document the data, procedures, and assumptions underlying each step of the methodology.

An overview of the audit trail procedures is outlined in Figure I-10. First, as data is obtained, its source and major features must be systematically documented in the data source index and library index. Furthermore, as data is distributed among analysts, its location must be tracked in the library index.

After being collected and entered in the SDT, the data will be analyzed in the ETES procedures. As each procedure is completed, the analytical steps in these procedures should be documented in the ETES worksheets. A description of each worksheet and its current location should also be entered into the library index.

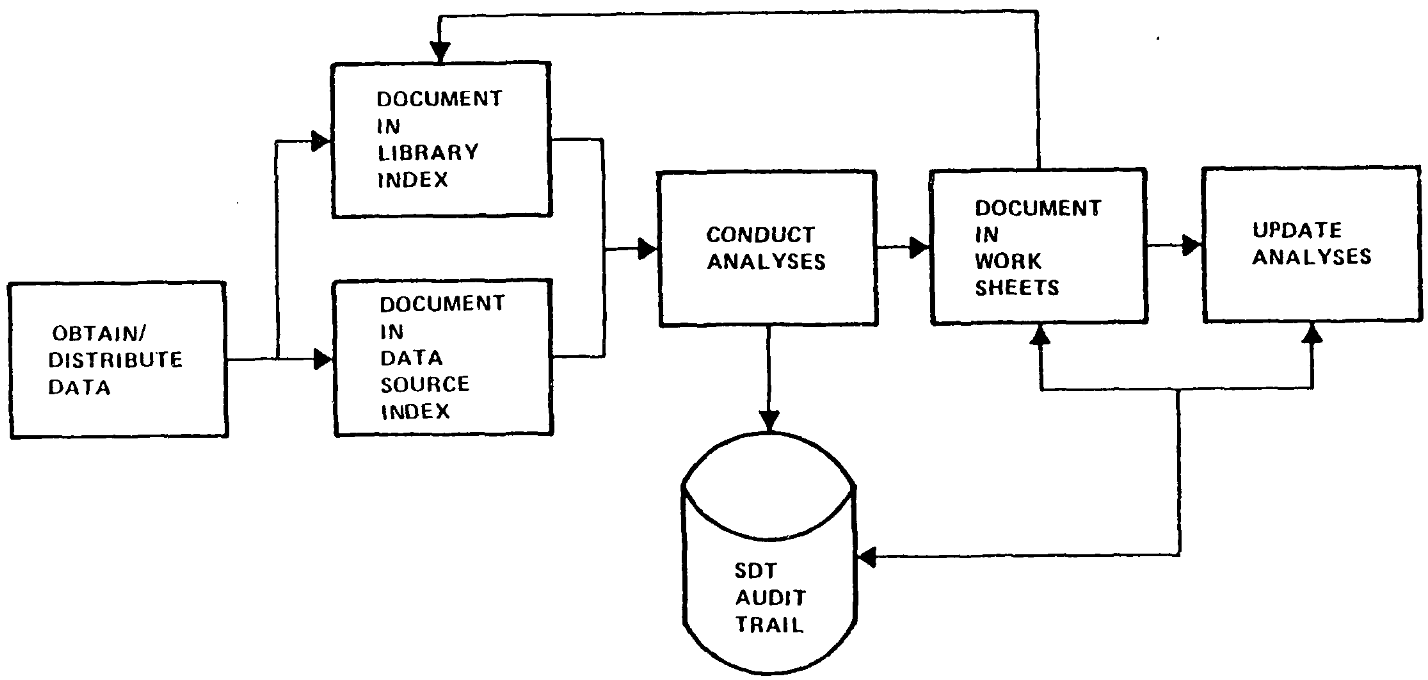

Figure I-10 Overview of Audit Trail Procedures

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As the system progresses, there will be frequent changes to its data elements. These changes should be documented in the SDT.

Worksheets. Worksheets are forms designed to describe the intermediary results of the analytical steps and algorithms in the ETES procedures. An example of a worksheet is presented in Table I-5. To assist the analyst in monitoring the audit trail, each worksheet should be assigned a unique identification number describing (1) the ETES function in which it is applied, (2) the equipment with which it is associated, (3) the MOS/ASI/skill level/duty position with which it is associated, and/or (4) the course with which it is associated. A listing of the ETES worksheets is presented in Table I-6.

I.7.2 ETES Study Plan Development

Prior to the application of the ETES TEAP and Evaluative Technology, a systematic study plan must be established. A potential outline for an ETES study plan is provided in Table I-7. There are four major questions which have to be asked during the development of a study plan:

(1) What resources will be available to conduct the ETES application?

(2) What is the scope of the study (i.e., what ETES procedures will be applied)?

(3) What is the focus of the study (i.e. on what elements of the system will the ETES procedures be applied)?

Table I-5. Example of ETES Worksheet.

System DSWS

Worksheet # ______ # 1 of 7

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
Hierarchical Functional Listing		New System				
Function Number* (a)	Function Name* (b)	System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e) H/W	S/W	Hum
	MIS W/S, Table 1-4					
1.0	Shoot	target servicing rate (tgts/hr) rate of fire (rpm-rounds per minute)	35-40 tgts/hour sustained rate, automatic, 8-12 rpm sustained rate, manual, ≥ 4 rpm			
		range (km)	max (assisted), ≥ 30 km max (unassisted) 20-25 km minimum (high angle), 3-5 km direct fire, .1-2.5 km			
		accuracy	guided round, 1-10 ft. range error (non-RAP), .25-.20% of range range error (RAP), .35-.30% of range azimuth error, .5-1 mil			
1.1	Load Weapon	inventory control/monitoring	automatic	x		x
1.2	Aim Weapon	pointing accuracy	.3-.5 mils	x	x	x
1.3	Arm the Weapon			x		x
1.4	Launch Weapon			x		

Table I-6. List of ETES Worksheets.

ETES Study Plan Outline (OUT)
Acquisition Information (ACQ)
Mission Profile (MIS)
System Performance Specification (PRF)
Organizational, Operational, and Support Concepts (OSC)
Operational Environment (ENV)
System Performance Specification (PRF)
Generic System (GEN)
Function Sequence (FSQ)
Baseline Comparison Equipment Selection (EQP)
BCS Equipment Description (BCS)
Baseline Comparison Performance Shortfall (PSH)
Design Difference (DD)
New System Equipment Description (EQP)
Candidate MOS (CND)
BCS Task Association (BCST)
New System Task Generation (NTA)
DIF Data Collection (DIF)
Task Data (PSYCRIT)
Select Tasks for Training (TSEL)
Media Assignment (MAS)
Media Selection Planning (MSEL)
Data Summary for Training Setting Assignment (SUMSET)
Skill and Knowledge (SKILL)
Target Population (POP)
Task/Skill Sequence (SEQ)
QPOI – Parts 1 & 2 (QPOI-1, QPOI-2)
Course Modification (MOD)
Training Path (PATH)
Number of Students – Steady-State (NSSS)
Phased Course Input Requirements (PHASE)
Number of Students to be Trained (NSTUD)
Number of Instructors (NINS)
Determine Training Facilities (DFAC)
Facilities Requirements (NFAC)
Determine Number of Training Devices/Equipments (TDEV)
Training Device/Equipment (DEEQ)

Table I-6. List of ETES Worksheets (Continued).

Determine Number of Media and Instructional Aids (NMED)
Number of Media/Aids (MEDSUM)
Ammunition Requirements (AMREQ)
Ammunition Requirements Summary Sheet (AMSUM)
Operating and Support Plan (OPSP)
Media Usage Rate (MUS)
Individual Course Cost (ICOST)
Course Aggregation (ACOST)
Training Summary (TVICE)
Method Rating (METH)
Task Rating for Instructional Methods (TAMOD)
Calculate Method Efficiency (METHEFF)
Calculate Overall Effectiveness Score (EFF)

TABLE I-7 ETES STUDY PLAN OUTLINE (OUT)

I. Available Resources and Costs

Labor	FY____	FY____	FY____	FY____	FY____
Category 1______________	____	____	____	____	____
Category 2______________	____	____	____	____	____
Category 3______________	____	____	____	____	____
Category 4______________	____	____	____	____	____
Category 5______________	____	____	____	____	____
Total	____	____	____	____	____
*in person-months					
Costs					
Category 1______________	____	____	____	____	____
Category 2______________	____	____	____	____	____
Category 3______________	____	____	____	____	____
Category 4______________	____	____	____	____	____
Category 5______________	____	____	____	____	____
Total	____	____	____	____	____
Computer Resources					
Category 1______________	____	____	____	____	____
Category 2______________	____	____	____	____	____
Category 3______________	____	____	____	____	____
Category 4______________	____	____	____	____	____
Category 5______________	____	____	____	____	____
Total	____	____	____	____	____

Table I-7 Study Plan (continued)

III. Study Focus

- System Functions to be included

General Function	Operation		Maintenance		Support
	All Functions	____	All Maint Functions	____	All Sppt Fun.
Subfunctions					

- System Equipments to be included

All Equipments		

Table I-7 (continued)

- Figures-of-Merit (FOM)

  - Cost
  - Efficiency
  - Effectiveness
  - Congruence with Training Development Guidelines
  - Congruence with Program Requirements
  - Training Complexity
  - Training Capacity
  - Feasibility
  - Impact on System Performance
  - Summary Evaluation Score (Place Check Beside FOM Included in Score)

- Teap Procedures to be Applied

	Function	Subfunction	Procedures
____	1.1	____	____
____	1.2	____	____
____	1.3	____	____
____	1.4	____	____
____	1.5	____	____
____	1.6	____	____
____	1.7	____	____
____	2.1	____	____
____	2.2	____	____
____	2.3	____	____
____	6.1.1	____	____
____	6.1.2	____	____
____	6.1.3	____	____
____	6.1.4	____	____
____	6.2.1	____	____
____	6.2.2	____	____
____	6.2.3	____	____
____	6.2.4	____	____
____	6.2.5	____	____
____	6.2.6	____	____
____	6.2.7	____	____
____	6.3.1	____	____
____	6.3.2	____	____

Table I-7 (continued)

- Evaluative Technology Procedures to be Applied

	Function	Subfunction	Procedures
____	7.1.1	____	____
____	7.1.2	____	____
____	7.1.3	____	____
____	7.1.4	____	____
____	7.1.5	____	____
____	7.1.6	____	____
____	7.1.7	____	____
____	7.1.8	____	____
____	7.2	____	____
____	7.3.1	____	____
____	7.3.2	____	____
____	7.4.1	____	____
____	7.4.2	____	____
____	7.4.3	____	____
____	7.4.4	____	____
____	7.5	____	____
____	7.6	____	____
____	7.6.1	____	____
____	7.6.2	____	____
____	7.6.3	____	____
____	7.6.4	____	____
____	7.6.5	____	____
____	7.6.6	____	____
____	7.6.7	____	____
____	7.6.8	____	____
____	7.6.9	____	____
____	7.6.10	____	____
____	7.7	____	____

(4) What data must be collected to support the study?

An overview of the procedures for developing the study plan is shown in Figure I-11. The analyst must first determine the total amount of resources available to conduct the analysis (see Table I-7). The resource and cost elements which are considered include labor, computer resources, and total available budget. The available resources place constraints on what can be accomplished in any particular ETES application.

For some functions, ETES provides alternative procedures for accomplishing several key training estimation functions. Resource constraints may place limits on which of these procedures the analyst may employ. Generally, the less data intensive procedures are the least costly. The analyst must select the procedure which fits his/her "pocketbook".

After the study resources have been determined the scope of the analysis, or more specifically, the specific ETES functions and procedures to be applied during the proposed application must be determined. ETES is an iterative set of procedures which can be applied repeatedly during the acquisition process. However, it may not be feasible to apply all of the ETES procedures during each application. Indeed, there is a logical sequence for applying the ETES procedures, (see Table I-8). Thus, as can be seen in Table I-8, a logical starting point for the application of the ETES would be to identify system functional requirements. If additional resources are available, the user would proceed to identify the system hardware/software design, and system task requirements and then to estimate training programs and paths, etc.

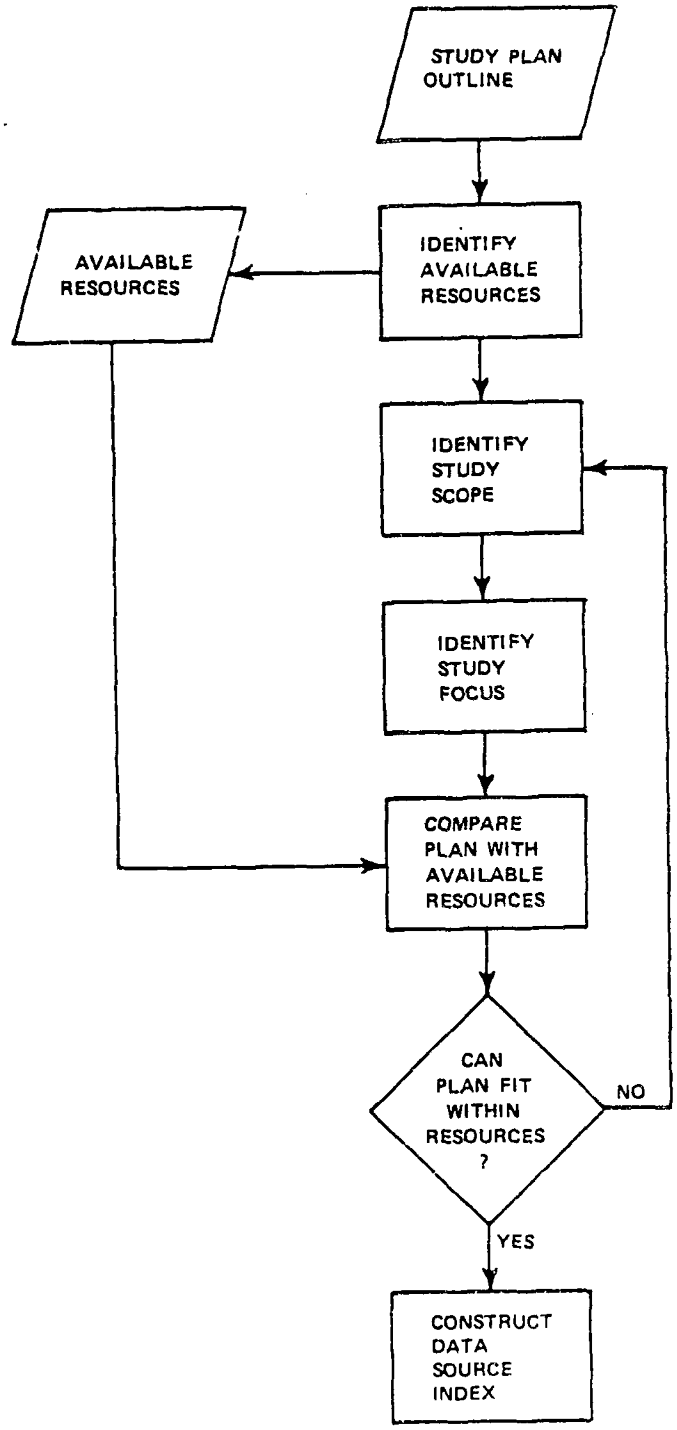

Figure I-11. Constructing a Study Plan.

Table I-8. Logical Sequence for Applying ETES Functions/Procedures

	Function	Sequence Grouping
1.0	Conduct Functional Requirements Analysis	1
2.0	Generate Tasks	2
3.0	Estimate Training Program	3
4.0	Estimate Training Resource	4
5.0	Determine Training Cost	4
6.0	Estimate Training Efficiency/Effectiveness	5
7.0	Evaluate Training Program	6
8.0	Develop Input to Acquisition Process	7

Following the identification of the study scope the study focus must be determined. Study focus refers to the level of detail to which the individual ETES procedures will be applied. Specification of the focus requires identifying (a) system functions to be examined, (b) system equipments to be examined, (c) MOS/duty positions to be examined, (d) types of training to be examined, and (e) figures-of-merit to be used in evaluating the training programs. Eight figures-of-merit are used in ETES: (1) cost, (2) training efficiency, (3) training effectiveness, (4) congruence with training development guidelines, (5) congruence with program requirements, (6) training complexity, (7) training capacity, and (8) a summary evaluating score combining the cost-effectiveness, and complexity measures.

The last step in the development of the study plan is the construction of the data source index. The data source index lists the major categories of data elements which must be collected during the study and the data sources from which these elements can be obtained (see Section I.7.1 for a more detailed description of the data source index and its role in overall ETES data management). A generic ETES data source index encompassing all ETES functions is provided in Appendix E.

An overview of the procedures for constructing a ETES data source index is presented in Figure 3-12. The user begins the construction of the data source index by examining the data categories listed in the generic data source index in Appendix E. Using the information from the ETES study plan, the user then selects the generic data elements needed to support the particular ETES functions to be applied. The user subsequently identifies lower level data elements by

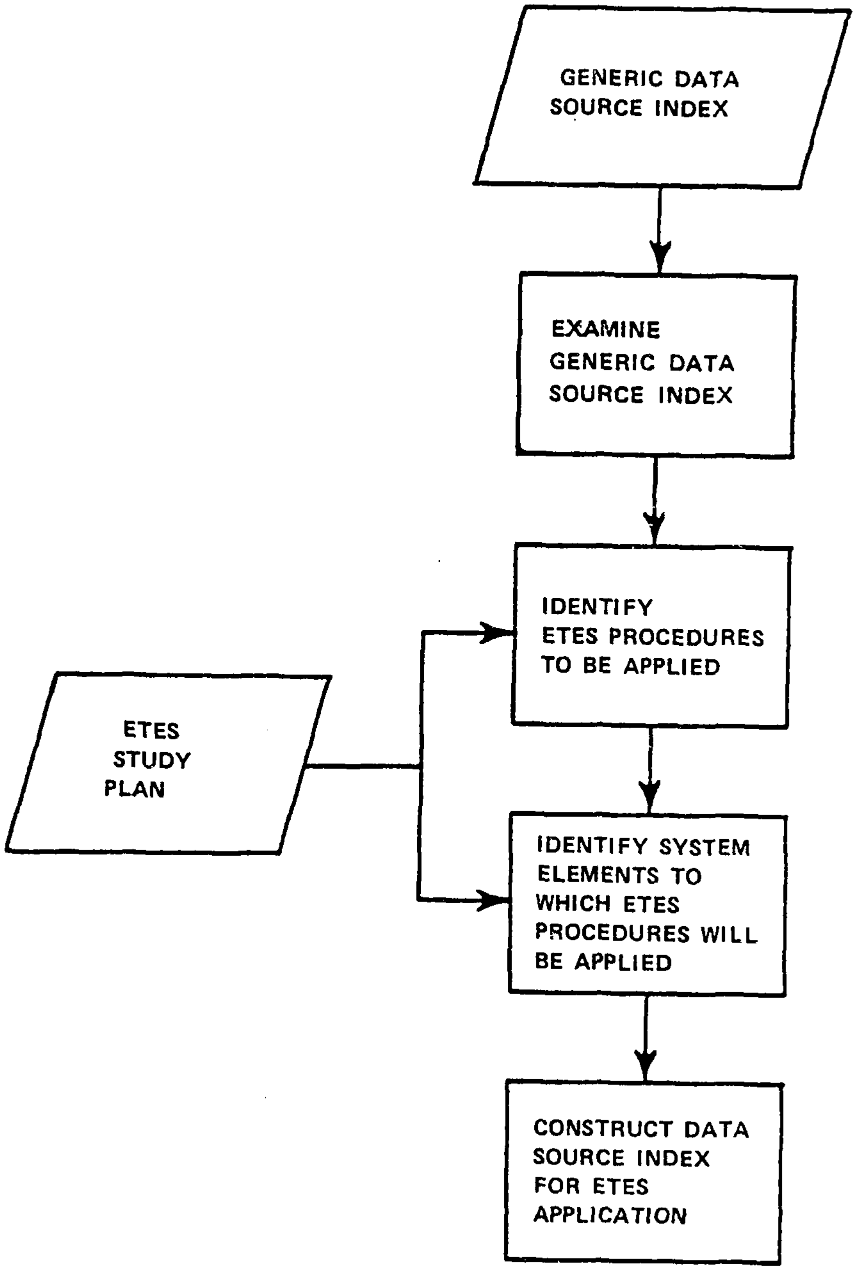

Figure I-12. Procedures for Developing Data Source Index.

examining the system elements, functions, equipments and MOS/duty positions to which the procedures will be applied. These system elements are described in the description of the study focus of the ETES study plan.

As soon as the data source index is constructed, the user should begin to identify interface requirements for all manual and automated data bases which must be accessed during the ETES application (see Figure I-12). Users should contact the relevant POCs for each data source to obtain up-to-date versions of their standard operating procedures (SOPs) for data requests. (Since SOPs change frequently, users should make sure they have up-to-date SOPs from the cognizant organizations.)

I.8 FORMAT USED TO DESCRIBE ETES PROCEDURES

The remaining sections of this guide (Sections 1-8) provided detailed descriptions of the ETES procedures. Table I-9 lists the procedures which are presented in each section. As one would expect from a training-oriented system, ETES procedures for identifying training-related produces (Procedures 2-8) are described in more detailed than the procedures for identifying functional requirements and other related information (Procedure 1).

Table I-9. Organization of Remaining Sections

1.0 Conduct Functional Requirements Analysis

- 1.1 Identify Required System Functions
- 1.2 Identify System Performance Measures and Goals
- 1.3 Allocate Required System Functions and Identify Lower Level Functions
- 1.4 Establish Baseline Comparison System
- 1.5 Identify Required System Improvements/New Technologies
- 1.6 Format New System Description

2.0 Generate Tasks

- 2.1 Identify, Collect and Format Data
- 2.2 Develop BCS Tasks
- 2.3 Assign BCS Tasks to MOS, Duty Position and Skill Level
- 2.4 Develop New System Task List
- 2.5 Assign New System Tasks to MOS, Duty Position and Skill Level

3.0 Estimate Training Program

- 3.1 Select Tasks for Training
- 3.2 Assign Tasks to Training Settings
- 3.3 Identify Skills and Knowledges
- 3.4 Develop Target Population Description
- 3.5 Sequence Tasks/Skills for Training
- 3.6 Construct Quasi-Program of Instructions
- 3.7 Assign Tasks/Skills to Media
- 3.8 Construct Training Paths

4.0 Estimate Training Resource

- 4.1 Develop Course Operating and Support Plan
- 4.2 Determine Number of Students to be Trained
- 4.3 Determine Instructor Requirements
- 4.4 Determine Facilities Requirements
- 4.5 Determine Training Device and Training Equipment Requirements
- 4.6 Determine Requirements for Other Training Resources

5.0 Determine Training Cost

- 5.1 Estimate Individual Course Costs
- 5.2 Aggregate Course Costs

6.0 Estimate Training Efficiency/Effectiveness

- 6.1 Estimate Training Efficiency
- 6.2 Estimate Training Effectiveness

Table I-9 (Continued)

7.0 Evaluate Training Program

- 7.1 Identify/Construct Figures of Merit
- 7.2 Identify Likely Problem Areas
- 7.3 Identify Likely Causes
- 7.4 Identify Alternatives
- 7.5 Evaluate Alternatives
- 7.6 Assess Impact of System Changes

8.0 Develop Input to Acquisition Process

- 8.1 Develop/Monitor Training Development Schedule
- 8.2 Develop Inputs to Acquisition Processes and Documents

SECTION 1.0 - CONDUCT FUNCTIONAL REQUIREMENTS ANALYSIS

OVERVIEW

During this procedure, system functional requirements are determined and functions are allocated to man, machine, and software. To assist in the identification of manpower, personnel, and training requirements, design concepts for a Baseline Comparison System (BCS) and New system are established.

The results of the functional analysis are entered into the System Description Technology (SDT). The SDT serves as the repository for information and data developed during functional analysis and insures that subsequent analyses of MPT requirements will be based on a common set of data.

PROCEDURE

This procedure consists of six lower level procedures. During the first procedure, high level system functional requirements are identified. In the second procedure, performance measures and goals are constructed for these functions. In the third procedure, lower level system functions are identified. In the fourth procedure, the Baseline Comparison System (BCS) is constructed. In the fifth procedure, required system improvements and new technologies are identified. In the sixth procedure, these new technologies are integrated into a systematic design concept for the New system.

The last two procedures are not necessary if a New system design concept is available from the Program Office. However, relevant information on the New system should be entered into the SDT using the guidelines contained in Procedures 1.5.3 and 1.6.3.

Potential data sources for functional requirements analysis procedures are listed in Appendix E.

1.1 IDENTIFY REQUIRED SYSTEM FUNCTIONS AND DETERMINE MPT STUDY REQUIREMENTS

OVERVIEW

The first step in conducting system functional analysis is to identify system functional requirements. This step is initiated by obtaining and reviewing any available functional requirements information on the New system such as that contained in the Justification for Major System New Start (JMSNS) and threat studies as well as similar information on the predecessor or other comparable systems. This information is used to identify and describe system missions and to generate high level functions and subfunctions.

PROCEDURE

An overview of procedure 1.1 is provided in Figure 1-1.

1.1.1 Identify Acquisition Characteristics

During the earliest phases of the acquisition process, information on system functional requirements can be

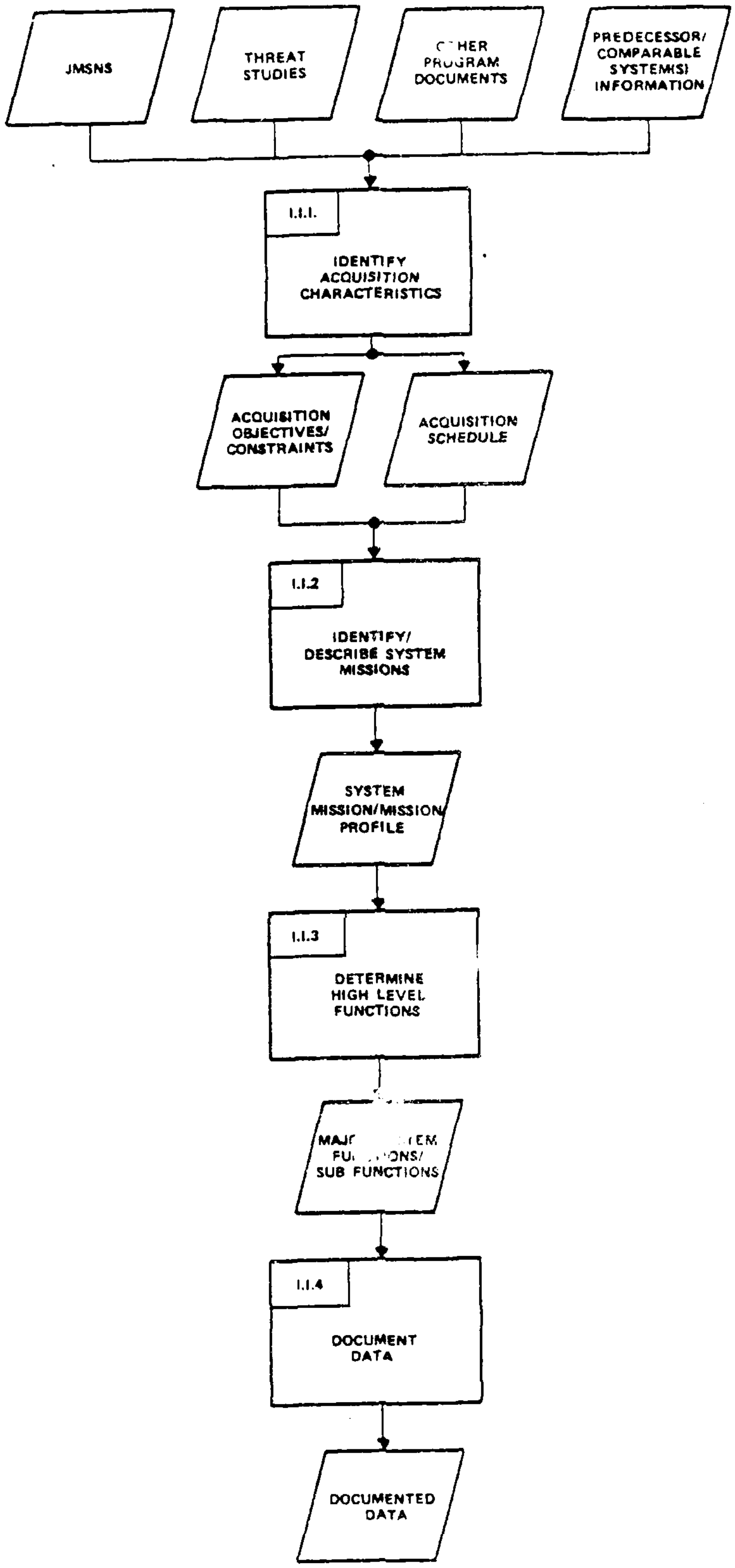

FIGURE 1-1. Overview Diagram: Identify Required System Functions and Determine MPT Study Requirements (1.1).

obtained from the Directorate of Combat Developments (DCD) at the TRADOC School associated with the developing system. Later, after a Program Manager (PM) has been appointed, this information can be obtained from the Program Office. The best source of information for functional requirements information during the early phases of a new acquisition is the Justification of a Major System New Start (JMSNS), formerly called a Mission Element Needs Statement (MENS). The purpose of the JMSNS is to identify a new threat and the requirement for a new weapon system. The JMSNS also explains the system's general operational and support envelope (as required in Office of Management and Budget (OMB) Circular A-109, DoD Direction 5000.1, and DoD Instruction 5000.2). An outline of the information elements contained in the JMSNS is presented in Table 1-1.

Table 1-1. Outline of Information Elements Contained in JMSNS

- Defense Guidance Element
- Mission and Threat
- Alternative Concepts
- Technology Involved
- Funding Implications
- Constraints
- Acquisition Strategy

The JMSNS must be supplemented with additional information such as feasibility or technology base studies, operation and support plans, mission area analysis results or other requirements documents. The availability of this kind of

documentation depends on the phase of the acquisition process the system has reached. Examples of documents which may contain information on general weapon system requirements are provided in Table 1-2. The documents listed in Table 1-2 should be available from (a) the Directorate of Combat Developments prior to the establishment of a PM or (b) the weapon system Program Management Office (PMO).

Table 1-2. List of Program Documents
For a New System

- Justification for Major System New Start (JMSNS)
- Mission Area Analysis (MAA)
- Technology base studies
- Army "86" and "90" studies
- Cost and Operational Effectiveness Analyses (COEA)
- TRADOC Scenarios
- Concept Analysis Agency Studies
- Battlefield Development Plan (BDP)
- Scenario Oriented Recurring Evaluation System (SCORES)
- Threat studies by OACSI/INSCOM
- Operational and Organizational Concepts
- Analysis of Technological Opportunities by TRADOC/ DARCOM
- Operation and Support Plans

Following the collection of available program documentation, a list of points of contact for obtaining additional system and acquisition program information should be developed.

Identification of points-of-contact begins with the collection of up-to-date organizational charts for the PMO, DCD, and major contractors (if a contractor has been selected). Points of contact are then interviewed (either in person or by phone) to obtain additional system information, program documentation, or further points of contact.

The weapon system requirements documentation will often list acquisition objectives and constraints which are not related to the performance of the system (e.g., cost and schedule constraints). These objectives and constraints may impact MPT requirements. The system acquisition schedule is of particular concern in this regard. The rate at which new systems move through the acquisition process and are fielded directly impacts the requirements for manpower, personnel, and training resources. MPT requirements can be developed for either steady state (constant number of systems operating per year) or phased situations (accounting for installation/retirement schedules). Each situation requires different types of acquisition schedule information. All acquisition objectives and constraints including the acquisition schedule should be documented on an Acquisition Information Worksheet (ACQ). Figure 1-2 contains a sample ACQ worksheet.

1.1.2 Identify/Describe System Missions

This step involves developing a mission profile/operational mode summary which contains a list of the New System mission(s) and the corresponding operational requirements. The mission profile consists of two parts; (1) a narrative description of potential New system missions and (2) quantitative data describing the operational requirements of

Figure 1-2 Acquisition Information Worksheet (A C Q)

System DSWS

Worksheet # ______

SDT Input/Output

1.1

Acquisition Objectives/Constraints		Acquisition Schedule								
		Planned or Estimated Schedule (c)		Steady-State Schedule			Phased Schedule			
Objectives (a)	Constraints (b)	Milestone	Date	IOC (d)	Systems Operating Per Year (Ave) (e)	Replacement Start/End Years (f)	IOC (g)	Operational and Technical Evaluation Schedule (h)	System Fielding Schedule (i)
Maintain ammunition commonality Utilize existing Supply Support System in developing support concept Minimize manpower/personnel Reduce training requirements	Cost - $4.5 Million per howitzer (1983 dollars) Manpower resources and personnel structure anticipated at IOC	ASARC/DSARC I	September, 1983	1/90	440	1990	1/96	TEMP 1/82, DT 1/87, OT 3/90	YEAR-1990 # 24 YEAR-1991 # 36 YEAR-1992 # 100 YEAR-1993 # 160 YEAR-1994 # 120

those missions. A worksheet for documenting mission profile data is presented in Figure 1-3.

Mission profile source documents may be obtained from the Directorate of Combat Developments (DCD) associated with the New system or the system program office. However, if this information is not available, the mission profile must be estimated via comparability analyses utilizing mission information for the predecessor or other comparable systems (procedures for identifying comparable systems are described in the Introduction and in Procedure 1.4).

Program documentation is used to identify and match New system missions (columns c and d) with predecessor/ comparable system missions (columns a and b). If information on the New system functions is already available, columns (a) and (b) may be left blank. Columns (e) and (f) describing the system functions should be filled in when Procedure 1.1.3 (Determine High Level Functions) is completed.

Quantitative data describing each mission function should be entered into columns (g) thru (k). These columns contain information on:

- percent operating time (column g),
- annual number of missions (column h),
- annual operating days (column i),
- mean duration (column j), and
- operating requirements for new system, in terms of key performance measures (e.g., miles driven per year) (column k).

Figure 1-3 Mission
Worksheet

System DSWS

Procedure 1.1

Predecessor/Comparable System		New System	
Mission Name (a)	Mission Characteristics (b)	Mission Name* (c)	Mission Characteristics
Table 1-3		Table 1-3	
Provide Fire Support	Short/Medium Range fire for purposes of (1) target engagements (2) counterfire	Provide Fire Support	Long/Short Range fire for purposes of: (1) target engagements (2) counterfire (3) air defense suppression (4) interdiction/deep fires
Survive in a Battlefield Environment	Periodic movement Secondary armament	Survive in a Battlefield Environment	Rapid and frequent movement to confuse enemy counterfire targeting ability and mask forc Defend against anticipated NBC environment secondary armament
Sustain Weapon Operations	Field resupply capability Fill maintenance capability	Sustain Weapon Operations	Provide for continuous resupply of ammunitic Field maintenance capability
		Tactical Positioning	Rapid and frequent movement over relatively distances while maintaining continuous fire operations

Profile Worksheet (MIS)

____

*SDT Input/Output

(d)	Major System Functions Required by Mission		Quantitative Data				
	Function Number (e)	Function (f)	Percent Operating Time (g)	Number of annual Missions (h)	Annual Operating Days (i)	Mean Duration (j)	Operating Req (k)
, diminish strength							
n							
short support							

If quantitative mission data is not available for the New system, this information should be estimated by using data from the predecessor or other comparable systems.

1.1.3 Determine High-Level Functions

In this step, major system functions are identified and a function hierarchy is developed. Major system functions should be listed in the program documentation identified in Procedure 1.1.2. These major functions form the framework for the system functional hierarchy. These major functions are then developed into a hierarchy, and listed in the first two columns of the System Performance Specification worksheet (PRF), displayed in Figure 1-4 (the remaining columns in this worksheet are completed in Procedures 1.2 and 1.3). The entire system functional hierarchy goes beyond identification of the major functions; it is a hierarchical listing of the functions which the new system must perform from the most general functional level (e.g., fire weapon at target) down to the level where specific subsystem functions (e.g., locate targets) are identified. Identification of functions below the subsystem level is accomplished in Procedure 1.3. High level functions should describe what the system must do not how it will do it. Examples of high level functions are presented in Figure 1-4.

Descriptions of system functions are likely to be available in the program documentation. However, program documentation and information are often incomplete and do not provide a systematic listing of system functions. Often, for instance, the program information focuses on those functions which are associated with potential improvements of the existing system. This treatment ignores existing functions

Figure 1-4 System Performance Specification Worksheet (PRF)

System DSWS

Worksheet # ______

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum
	MIS W/S, Table 1-4					
1.0	Shoot	target servicing rate (tgts/hr) rate of fire (rpm-rounds per minute)	35-40 tgts/hour sustained rate, automatic, 8-12 rpm sustained rate, manual, ≥ 4 rpm			
		range (km)	max (assisted), ≥ 30 km max (unassisted) 20-25 km minimum (high angle), 3-5 km direct fire, .1-2.5 km			
		accuracy	guided round, 1-10 ft. range error (non-RAP), .25-.20% of range range error (RAP), .35-.30% of range azimuth error, .5-1 mil			
1.1	Load Weapon	inventory control/monitoring	automatic	x		x
1.2	Aim Weapon	pointing accuracy	.3-.5 mils	x	x	x
1.3	Arm the Weapon			x		x
1.4	Launch Weapon			x		

Figure 1-4 System Performance Specification Worksheet (PRF) (Continued)

Worksheet # ________

System DSWS

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum.
	MIS W/S, Table 1-4					
2.0	Navigate					
2.1	Determine Position	Location accuracy Altitude accuracy Attitude accuracy	15-20 meter radius 2-10 meter 1.0 mil	x		
2.2	Determine Destination					x
2.3	Determine Route					x
3.0	Move					
3.1	Displace Weapon	Displacement Time	0-30 seconds			x
3.2	Relocate Weapon	Speed (KPH)	Primary Roads, 60-75 Secondary Roads, 40-45 Trails, 25-30 Cross Country, 15-20 10% Grade, 40	x		x

Figure 1-4 System Performance Specification Worksheet (PRF) (Continued)

System DSWS   Worksheet # ______   *SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Huma
	MIS W/S, Table 1-4					
3.2	Relocate Weapon (cont'd)	Night Vision Degrade	10%			
		HP/ton	18-22			
		Cruising Range (Km)	400-600 km			
		Slope % Capability	Ascending 60% Side 40%			
		Obstacle Crossing Capability	Vertical 21-36 in. Trench 72-96 in. Fording Depth 42-46 in.			
3.3	Emplace Weapon	Emplacement Time	< 60 seconds			
4.0	Perform Support Services					
4.1	Provide Maintenance Support	MTBF MTBCMA MTTR	Specified for each major subsystem 0.5 hr			
4.2	Provide Supply Support					

which still must be performed by the system but not necessarily in an improved manner. Therefore, the program information may have to be supplemented in order to develop a complete set of hierarchical system functions. To accomplish this, the user may also have to obtain functional information on the predecessor system and/or other existing systems which perform functions similar to those required of the New system. More details on the identification of predecessor and comparable system data and the identification of high level functions are provided in the paragraphs below.

- IDENTIFICATION OF PREDECESSOR AND OTHE COMPARABLE EXISTING SYSTEMS

The Predecessor system (that is, the system which the new system is designed to replace) should be identified in the requirements documents identified during Procedure 1.1.

Comparable existing systems are identified in a two-step process. First, the functional area associated with the New system is identified. A list of functional areas and the major systems within these functional areas is provided in Table 1-3. Second, the existing system within the functional area which most closely matches the requirements of the New system is identified. If the user is not familiar with the systems in the functional area, he/she should contact subject experts from the school within the designated functional areas to obtain assistance in identifying comparable existing systems.

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS*

PROPONENT	SYSTEMS AND AREAS
US Army Air Defense School	System Peculiar Equipment: HAWK Missile (Operator/Organizational maintenance) HERCULES Missile (Operator/Organizational maintenance) CHAPARRAL Missile (Operator/Organizational maintenance) REDEYE Missile (Operator/Organizational maintenance) ROLAND Missile (Operator/Organizational maintenance) VULCAN Gun (Operator/Organizational maintenance) M42 (40mm Self-Propelled) Command and Control Radar Systems NA/TSQ-73 (Organizational, DS/GS maintenance) AN/TSQ-38 (Organizational, DS/GS maintenance) FAAR (Organizational maintenance) PATRIOT (Operator/Organizational maintenance) DIVAD Gun (Operator/Organizational maintenance) Functional Areas: Air Defense Systems Employment and Operations
US Army Armor School	System Peculiar Equipment: Techniques of Firing: Submachinegun (M3A1) Coaxial Machinegun M85-50 Machinegun Armored Vehicle Operations XM1 Tank M551 (Armored Reconnaissance Vehicle) M557 (Command Post Vehicle) M578 (Light Recovery Vehicle) M88 (Tank Recovery Vehicle) Calvary Fighting Vehicle (CFV)

* Taken from TRADOC Cir 351-1. Common Job and Task Management.

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Armor School (Cont)	Functional Areas: Combat Reconnaissance
US Army Chaplain Center and School	Functional Areas: Religious Activities Pastoral Counseling
US Army Engineer School	System Peculiar Equipment: Prime Power Generation Equipment Combat Engineer Vehicle (CEV) Armored Vehicle Launched Bridge (AVLB) Engineer Construction Equipment Engineer Support Equipment Tactical Utility/Precise Power Electric Generation Equipment (Operator/Crew, DS/GS maintenance) Topographic/Cartographic Equipment Welding Equipment - ARC (DS/GS maintenance) Night Vision Material (other than Common Thermal) (DS/GS maintenance) Functional Areas: Mine/countermine Operations Military Bridging Map Reading Camouflage Operations Demolitions Field Fortifications Route Reconnaissance Obstacles Fire Protection/Fire Safety Refrigeration, Air Conditioning, Heating Environmental Protection
US Army Field Artillery School	System Peculiar Equipment: Cannons (Operator maintenance) LANCE Missile (Organizational maintenance) PERSHING Missile (Organizational maintenance) Field Artillery Target Acquisition systems

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Field Artillery School (Cont)	Functional Areas: Observed Fire
US Army Infantry School	System Peculiar Equipment: Rifles Machineguns Grenade Launcher M203 Rocket Launcher M20A1, M20B1 HEAT Rockets Flame Weapons Weapons Oriented Night Vision Devices PVS-2 PVS-5 TVS-2 TVS-4 Anti-Tank Weapons TOW (Operator maintenance) DRAGON (Operator maintenance) LAW 106 RCLR 90 RCLR Hand Grenades Infantry Fighting Vehicle (IFV) M113A1 APC M114 APC Improved TOW Vehicle (ITV) Functional Areas: Operations Ranger Operations Physical Fitness Visual Signals Leadership Anti-Armor Warfare Jungle Operations Air Mobile Operations Air Assault Operations Airborne Operations Land Navigation Security and Combat Patrols Early Warning Devices

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Intelligence School (Devens)	System Peculiar Equipment: Electronic Warfare/Signal Intelligence (EW/SIGINT) Analysis EW/SIGINT Non-Morse Interception EW/SIGINT Morse Interception EW/SIGINT Voice Interception EW/SIGINT Emitter Identification/Location EW/SIGINT Noncommunications Interception EW/INTERCEPT Equipment Repair Signal Security
US Army Intelligence Center and School (Huachuca)	Functional Areas: Imagery Intelligence Interrogation Ground Surveillance Radar Operations Remote Sensor Operations Combat Area Surveillance Radar Repair Aerial Surveillance Sensor Maintenance Aircraft Survivability Equipment Repair Intelligence Analysis Counter-Intelligence Aerial Sensor Operations Safeguarding Classified Documents (except storage, receipt, and transfer) Intelligence
US Army Military Police School	Functional Areas: Civil Disturbances Physical Security Rear Area Protection Crime Prevention Criminal Investigation Techniques of Firing: .45 Caliber Pistol .38 Caliber Pistol Prisoner of War
US Army Missile and Munitions Center & School	System Peculiar Equipment: LANCE Missile (DS/GS maintenance) PERSHING Missile (DS/GS maintenance) HAWK Missile (DS/GS maintenance) HERCULES Missile (DS/GS maintenance)

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Missile and Munitions Center & School (Cont)	CHAPARRAL Missile (DS/GS maintenance) REDEYE Missile (DS/GS maintenance) ROLAND Missile (DS/GS maintenance) PATRIOT Missile (DS/GS maintenance) DIVAD Gun (DS/GS maintenance) VULCAN Gun (DS/GS maintenance) SHILLELAGH (DS/GS maintenance) TOW (DS/GS maintenance) DRAGON (DS/GS maintenance) Forward Area Alerting Radar (FAAR) (DS/GS maintenance) LCSS Functional Areas: Munitions Handling, Storage, Inspection, and Maintenance Explosive Ordnance Disposal & Equipment Missile Test Measurement and Diagnostic Equipment Aviation Life Support Equipment (Pyrotechnics-R&D, storage, and issue) Calibration and Related Support Equipment
US Army Ordnance and Chemical Center and School	System Peculiar Equipment: Wheeled Vehicles (maintenance) Tracked Vehicles (maintenance) Power Generating Equipment (maintenance) Materials Handling Equipment (maintenance) Small Arms (maintenance) Artillery Maintenance (Non-Missile) Ground Support Equipment (maintenance) Cannons (DS/GS maintenance) Chemical Equipment (maintenance) Turret Maintenance Recovery (Less Aircraft/Watercraft) Compressors (Shop) (Organizational/DS maintenance) Laser - General Purpose (Organizational/DS maintenance) Laundry Equipment (Organizational/DS maintenance) Metal Working and Machining Equipment (Organizational/DS maintenance) Tire Repair Equipment (DS maintenance) Welding Equipment - ARC (Organizational maintenance) Welding Equipment (Other) (Organizational/DS maintenance)

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Ordnance and Chemical Center and School (Cont)	Functional Areas: NBC Defense SMOKE Equipment and Employment NBC Defensive Materiel Chemical Support Equipment (Organizational/DS maintenance)
US Army Quartermaster School	System Peculiar Equipment: Supply (Automated & Manual) Food Service Functional Areas: Airdrop Equipment Supply and Rigging Exchange, Textile, and Leather Support Fabric Material and Repair Subsistence and Food Service Equipment Memorial Activities Laundry, Clothing Exchange, and Bath Operations Materials Handling Equipment (Operation) Office Machines and Repair Organization Maintenance and Storage of Small Arms Packaging, Packing, and Crating Petroleum Supply, Equipment, and Operations Procurement and Production Property Disposal Shelters (General Purpose - Soft Wall) Storage Supply and Supply Management Operations (Except: Medical, Ammunition, ADP, and Cryptographic) The Army Maintenance Management Systems (TAMMS) Materiel Management
US Army Signal School	System Peculiar Equipment: Radio/Cable Functional Areas: Audiovisual Equipment Antennas Message Processing TMDE

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Signal School (Cont)	Functional Areas: Television Equipment TV Production ADP Equipment ADP Peripheral Equipment Data Communication Equipment Avionic Navigation and Flight Control Equipment Avionic Communications Equipment Tactical FM Radios Manual Switchboards C-E Maintenance Administration Electronic Switchboards Telephones Generators (Signal) COMSEC Equipment Patching Panels Converters Central Office Equipment Multiplexers Combat C-E Planning C-E Engineering Power Supplies System/Technical Control Equipment Printed Circuit Boards HF Radios Public Affairs Radio Set Control Groups Electronic Switchboards Facsimile Equipment Fixed Telecommunications Systems Planning Photographic Equipment Watercraft Navigational Aids Land Navigation Positioning Equipment Ground Control Approach Equipment Illustration Multichannel Equipment Message Processing Material Management (for Signal Equipment) Radio Wire Integration (RWI) Radiotelephone Procedures Radio Teletypewriter Equipment (RATT) Signal Security Signal Records and Reports Specialized C-E Skills Strategic Microwave Equipment

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Signal School (Cont)	Strategic Satellite Equipment Specialized Signal Equipment Teletypewriter Equipment Tactical Satellite Equipment Tactical Microwave Equipment Tabulating Equipment Wire and Cable Communications/Operations
US Army Transportation School	Functional Areas: Wheeled Vehicle Operations (Except Special Use Equipment) Aviation Maintenance Marine Operations and Maintenance Rail Operations and Maintenance
US Army Institute of Military Assistance	Functional Areas: Civil Affairs Survival, Evasion, Escape, and Resistance (SEER) Psychological Operations Special Forces Operations Security Assistance Foreign Area Specialty Low Intensity Conflict (LIC) Civil Military Operations US Army Participation in Counter Terrorist Operations Defense Against Enemy Psychological Operations
US Army Admin Center	Functional Areas: Administrative Services Records and files management Correspondence management Routing of official mail Micromation Word processing Forms management Printing and reproduction Publications supply Command publications and orders Postal operations

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Admin Center (Cont)	Functional Areas: Storage, transfer, and control of classified documents Reports control Unit mail operations Article 15* Summary courts Martial* Special courts Martial* Article 32 investigations* Claims* Court reporting*
	Finance services Military pay and allowances Travel allowances Commercial accounts Civilian pay Disbursing operations JUMPS Army management
	Comptrollership Planning, programming and budgeting Program review Internal review (auditing) Accounting systems and procedures Management analysis of programs Manpower management
	Computer Science ADP management ADP systems analysis Computer programming ADP equipment operations
	Personnel Management Recruiting and retention Personnel management techniques Professional ethics Club and restaurant management Morale and recreation services
	Personnel Services SIDPERS Casualty reporting OERs

*Enlisted tasks only

TABLE 1-3. SYSTEMS AND FUNCTIONAL AREA PROPONENTS (continued)

PROPONENT	SYSTEMS AND AREAS
US Army Admin Center (Cont)	EERs/SEERs Personnel assignments/utilization Personnel classification/reclassification MOS classification/reclassification Awards and decorations Separations Promotions/reductions Personnel requisitioning/PERDDIMS Personal affairs Personnel records VTAADS
	Other Equal opportunity Personnel and financial management information systems
Academy of Health Sciences, US Army	<u>Functional Areas:</u> First Aid Lifesaving Measures Medical Evacuation Emergency Medical Care Dental Care & Services Veterinary Care & Services Health Care Management, Patient Care, Rehabilitation Clinical Counseling
US Army Aviation Center and Fort Rucker	<u>System Peculiar Equipment</u>: Air Traffic Control Flight Operation Coordination
	<u>Functional Areas:</u> Aviation Safety Aviation Standardization
US Army Training Board	<u>Functional Areas:</u> Management of Military Training in Units
The Judge Advocate General School	<u>Functional Areas:</u> Military Justice Geneva/Hague Convention and Laws of War

o IDENTIFICATION OF HIGH-LEVEL FUNCTIONS

High-level functions must be identified down to the subsystem level (i.e., the level at which further identification of functions is not possible without allocating functions to people, hardware, or software).

Sources for the identification of system functions include system doctrinal literature, system operational concepts, mission area analyses, ARTEPs and the Battlefield Development Plan for the functional area involving the New system. The Battlefield Development Plan contains the umbrella operational concept for the functional area. A list of doctrinal literature for each functional area is provided in Table 1-4.

Once a list of potential high level functions is identified, these functions should be sorted and arranged in hierarchical order.

Each function should then be assigned a number which specifies its place in the functional hierarchy. For example, the highest level functions would be designated 1.1, 1.2, 1.3 or 2.1, 2.2, 2.3, etc. Lower level functions, then, would be designated with 3 digits, etc.

When the identification of high level functions has been completed the system function numbers titles should be entered into columns (a) and (b) of the PRF worksheet (see Figure 1-4).

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS

ACADEMY OF HEALTH SCIENCES

Publications	Title	Remarks
FM 8-10	Health Svc Spt in T.O.	
FM 8-15	Health Svc in CZ	
FM 8-21	Health Svc in Comm Zone	
FM 8-25	Cbt Medic	
FM 8-26	Dental Svc	
FM 8-27	Vet Svc	
FM 8-999C	The Med Plt	
FM 8-999D	The Div Med Rn	
FM 8-999F	The Combat Zone Hospital	
FM 8-999G	Ground Evac Units	
FM 8-999H	Air Evac Units	
FM 8-999I	The Clearing Co	
FM 8-999J	C & C Combat Zone Health Svc Ops	
FM 8-999K	The MEDSON	
FM 8-999L	MED Intel	
FM 8-999M	Dispensary Detach	
FM 8-999N	The COMMZ Hospital	
FM 8-999O	Convalescent Center	
FM 8-999P	Preventive Medicine Detach	
FM 8-999Q	C & C COMMZ Health Svc Ops	
FM 8-999R	Med Lab	
FM (J) 8-8	Med Spt in Jt Ops	TRADOC Approved
FM (J) 8-9	NATO Handbook on the Medical Aspects of NBC Defensive Ops	TRADOC Approved

AIR DEFENSE

FM 44-1	ADA Employment	
FM 44-1-1	Air Defense Artillery Ops	
FM 44-1-A	ADA Materiel	
FM 44-1-B	ADA Materiel (Nike Herc)	
FM 44-2	ADA Employment (Auto Wpns)	
FM 44-3	ADA Employment, CV	
FM 44-10	Roland AD Bn Ops	
FM 44-11	DIVAD Gun ADA Bn Ops	
FM 44-15	Patriot ADA Bn Ops	
FM 44-18	Stinger Plt and Section Ops	
FM 44-23	Redeye Employment	
FM 44-70	C&C System AN/TSQ-73	
FM 44-72	C&C of SHORAD Wpns	
FM 44-90	ADA Employment, HAWK	
FM 44-95	Nike/Herc Employment	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	ARMOR	
FM 17-47	Air Cav Bde Combat Bde	
FM 17-50	Attack Helo Ops	
FM 17-95	Cavalry	
FM 71-1	Tank & Mech Inf Co Team	
FM 71-2	Tank & Mech Inf Bn Task Force	
FM 90-3	Desert Ops	
	AVIATION	
FM 1-2	Aircraft Battlefield Countermeasures and Survivability	
FM 1-60	Army Airspace Mgt and Air Traffic in a Combat Zone	
FM 90-1	Employment of Army Aviation Units in a High Threat Environment	
TC 1-3	Army Aviation Employment on an Integrated Battlefield	
	CHAPLAIN	
FM 16-5	The Chaplain	
FM 16-22	Conducting Military Funerals and Memorials	
	CHEMICAL SCHOOL	
FM 3-4	Collective Protection	
FM 3-5	NBC Decontamination	
FM 3-8	NBC Support Operations	
FM 3-9	Military Chemistry & Biology Defense	
FM 3-10-1	Employment of Chemical Agents	
FM 3-10-2	Chemical Effects Data	
FM 3-10-3	Field Behavior of Chemical Agents	
FM 3-12	Operational Aspects Radiological Defense & Fallout Predictions	
FM 3-15	Nuclear Accident Contamination Control	
FM 3-50	Deliberate Smoke Ops	
FM 3-87	NBC Reconn/Decon Ops	
FM 3-100	NBC Opns	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	COMBINED ARMS CENTER	
M 7-30	The Infantry Airborne and Air Assault Bde Ops	
M 22-100	Military Leadership	TRADOC Approved
M 22-101	Leadership Counseling	TRADOC Approved
M 71-3	Armored & Mech Bde Ops	
M 71-100	Armored & Mech Div Ops	TRADOC Approved
M 71-101	Inf, AB and Air Assault Div Ops	
M 90-2	Tactical Deception	
M 90-6	Mountain Ops	
M 90-10	Military Ops in Urbanized Terrain	
M 90-11	Winter Ops	
M 90-13	River Crossing Ops	
M 90-14	Rear Area Cbt Ops	
M 100-1	The Army	TRADOC Approved
M 100-5	Operations	TRADOC Approved
M 100-15	CORPS	TRADOC Approved
M 100-16	EAC	TRADOC Approved
M 100-26	The Air/Ground Ops System	
M (J) 100-27	USA/AF: Doctrine for Theater Airlift and Jt Airborne Ops	TRADOC Approved
M (J) 100-28	Doctrine and Procedures for Airspace Control in CZ	TRADOC Approved
M (J) 100-40	Armed Forces Doctrine for Chem Warfare and Bio Wpns Defense	TRADOC Approved
M (J) 100-42	USA/AF: Airspace Mgt in AO	TRADOC Approved
M (J) 100-43	The Landing Force	TRADOC Approved
M 101-5	SOFM: Staff Org and Procedure	
M 101-5-1	Operational Terms & Graphics	
M 101-10-1	SOFM: Org, Tech, Log Data	
M 101-10-2	SOFM: Org, Tech, Log Data	
M 101-10-3(S)	SOFM: Org, Tech, Log Data	
	COMMUNICATIONS COMMAND	
M 11-23	Theater Army Commo Cmd	
M 11-25	Signal Co Troposcatter	
M 11-26	Signal Hq Ops Co, Signal Spt Co	
M 11-27	Signal Cable Construction Bn	
M 11-28	Signal Long Line Co	
M 11-29	Sig Msg Co, Sig Radio Ops Co	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	DEFENSE INFORMATION SCHOOL	
FM 45-1	Public Affairs Ops	TRADOC Approved
	ENGINEER	
FM 5-100	CBT Eng Ops	
FM 5-101	Mobility	
FM 5-102	Survivability	
FM 5-103	Countermobility	
FM 5-104	General Engineering	
FM 5-105	Topographic Ops	
FM 5-106	ADM Ops	
FM 5-107	Engineer Combat Missions	
FM 5-108	Eng Special Ops	
	FIELD ARTILLERY	
FM 6-1	TACFIRE Ops	
FM 6-20	Fire Support in Combined Arms Ops	
FM 6-20-1	FA Cannon Bn	
FM 6-20-2	DIVARTY, Corps FAS, FA Bde	
FM 6-42	Lance Bn	
FM 6-42-1(C)	Lance Bn	
FM 6-50	FA Cannon Btry	
FM 6-60	MLRS	
FM 6-121	FA Target Acquisition	
TC 6-1-2	Battery Computer System	
TC 6-20-3	Fire Support Operations in Brigade Sized Units	
TC 6-20-5	FASCAM	
TC 6-20-7	FAC/FIST	
TC 6-30-1	GLLD/Copperhead	
TC 6-45-1	MLRS	
TC 6-50-1	Direct Spt Cannon Bn	
TC 6-50-2	FA Cannon Unit Nuclear Ops	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	INSTITUTE FOR MILITARY ASSISTANCE	
FM 31-22	Command, Control and Spt of SF Ops	
FM 31-26	SF Selected Ops Tech	
FM 33-1	PSYOPS	
FM (J) 41-5	Joint Manual for CA	TRADOC Approved
FM 41-10	Civil Affairs Ops	TRADOC Approved
FM 100-20	Low Intensity Conflict	
	INFANTRY	
FM 7-7	The Mechanized Infantry Platoon/Squad	
FM 7-7-1	The Mechanized Infantry Platoon and Squad (IFV)	
FM 7-8	The Infantry Platoon/Squad	
FM 7-10	The Rifle Co	
FM 7-20	The Infantry Battalion (Inf, Abn, Air Asslt, Rgr)	
FM 7-999A	Tactical Employment of Mortars	
FM 21-75	Combat Training of the Soldier	
FM 31-18	Long Range Reconnaissance Ranger Company	
FM 57-38	Pathfinder Operations	
FM 71-1	The Tank and Mechanized Infantry Co Team	
FM 71-2	The Tank and Mechanized Infantry Battalion Task Force	
FM 90-4	Airmobile Operations	
FM 90-5	Jungle Operations	
FM 90-8	Counter-guerrilla Operations	
FM 90-10-1	An Infantryman's Guide to Urban Combat	
	INTELLIGENCE - DEVENS	
FM 34-3	Intel Analysis	
FM 34-4	CEWI Commo & Data Clinics	
FM 34-12	Collection and Jamming Co	
FM 34-13	Plt Ldr/Tm Ch Hdbk	
FM 34-23	TAC Exploitation Bn	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	INTELLIGENCE - DEVENS (Cont)	
FM 34-31	CEWI Co/Detachment	
FM 34-32	CEWI Spt for ADA	
FM 34-40	EW Ops	
FM 34-41	Jamming Hdbk	
FM 34-51	SIGINT/EW Templating	
FM 34-62	SIGSEC Tech	
FM 90-2A	Electronic Deception	
TC 34-41	Jamming Handbook	
	INTELLIGENCE - HUACHUCA	
FM 34-1	Intel & EW Ops	
FM 34-2	Mgt of Intel & EW Ops	
FM 34-10	CBT EW and Intel Bn (Div)	
FM 34-11	Ground Surveillance Co CEWI Bn	
FM 34-14	Svc Spt Co CEWI Bn-Div	
FM 34-20	CBT EW and Intel GP (Corps)	
FM 34-21	Ops Bn, CEWI GP (Corps)	
FM 34-22	Aerial Exploitation Bn, CEWI GP	
FM 34-30	CEWI Co (ACR/SEP Bde)	
FM 34-33	CEWI Spt to Arty	
FM 34-52	Intel Interrogation	
FM 34-53	Recon & Surveillance	
FM 34-60	Tactical Counterintel Ops	
FM 34-61	Counterintel Special Ops	
FM 34-65	OPSEC Spt	
FM 34-80	BN/Bde S2 Hdbk	
FM (J) 34-81	Weather Intel in Spt of Army Tactical Ops	TRADOC Approved
TC 34-50	Recon/Surveillance Handbook	
	LOGISTICS CENTER	
FM 29-20	Maintenance Mgt in T.O.	
FM 31-82	Base Development	
FM 54-6	Theater Army Area Cmd	
FM 54-7	Theater Army Logistics	
FM 63-1	CSS Ops-Sep Bde	
FM 63-2	CSS Ops-Div	
FM 63-3	CSS Ops-Corps	
FM 100-10	Combat Service Support	TRADOC Approved

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	MISSILE AND MUNITIONS CENTER AND SCHOOL	
FM 3-20	Tech Escort Ops	
FM 3-21	Chem Accident Contamination Ctl	
FM 9-6	Ammo Svc in the T.O.	
FM 9-13	Ammo Hdbk	
FM 9-15	Explosive Ord Disposal Unit Ops	
FM 9-16	Explosive Ord Recon	
FM 9-38	Conventional Ammo Unit Ops	
FM 9-47(84)	Special Ammo Unit Ops	
FM 9-59	Missile Spt Unit Ops	
FM 29-27	Calibration Svc in the T.O.	
	MILITARY POLICE	
FM 19-1 (Capstone)	Operational Concepts of MP on the Battlefield	
FM 19-4	MP Team, Squad, Platoon Cbt Ops	
FM 19-10	MP Operations	
FM 19-15	Civil Disturbances	
FM 19-16	Counterterrorism	
FM 19-20	Law Enforcement Investigation	
FM 19-30	Physical Security	
FM 19-40	Enemy POW, Civilian, Internees & Detained Persons	
FM 19-60	Confinement and Correctional Treatment of Military Personnel	
	NUCLEAR AND CHEMICAL AGENCY	
FM (J) 101-31-1	SOFM: Nuke Wpns Employ Doctrine and Procedures	TRADOC Approved
FM (J) 101-31-2	SOFM: Nuke Wpns Employ Effects Data	TRADOC Approved
FM (J) 101-31-3	SOFM: Nuke Wpns Employ Effects Data	TRADOC Approved

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	ORDNANCE CENTER	
FM 29-2	Organizational Maintenance Ops	
FM 29-23	Direct Spt Maintenance Ops (nondivisional)	
FM 29-24	General Spt Maintenance Ops	
FM 29-30-1	Div Maintenance Bn	
FM 29-35	Maint Spt in Separate Bde	
FM 29-999	Division Maintenance Ops	
FM 43-1	Org Maintenance Managers Guide	
FM 43-1-1	Org Maintenance Managers Checklist	
	QUARTERMASTER	
FM 10-27	General Supply in T.O.	
FM 10-60	Subsistence Supply and Management in T.O.	
FM (J) 10-63	Handling of Deceased Personnel in T.O.	TRADOC Approved
FM 10-67	Petrol Supply in T.O.	
FM 29-10	Supply Mgt in the Field Army	
FM 29-19	Repair Parts Supply in T.O.	
FM 29-45	GS S&S in the Field Army	
FM 29-51	Div Supply Ops	
FM 29-52	Supply and Field Svc Ops in Sep Bde and Armored Cav Regiments	
FM 29-999B	Forward Supply Co	
	SCHOOL OF MUSIC	
FM 12-50	The Military Band	
	SIGNAL	
FM 11-40	TAC Audiovisual Doctrine	
FM 11-44	ADA Signal Ops Bn	
FM 11-50	CBT Commo w/i the Div	
FM 11-92	CBT Commo w/i the Corps	
FM 24-1	CBT Commo	
FM 24-2	Radio Freq Mgt	
FM 24-17	TAC Comm Ctr Ops	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	SIGNAL (Cont)	
FM 24-18	Field Radio Tech	
FM 24-20	Field Wire/Field Cable Tech	
FM 24-21	TAC Multichannel Radio Commo Tech	
FM 24-22	Commo Electronic Mgt System (CEMS)	
FM 24-26	TAC Auto Switching (TTC-38)	
FM 24-27	TAC Auto Switching (TTC-39)	
FM 24-28	TAC Auto Msg Switching	
FM 24-29	TAC Commo Center Facility & Ops (TSQ-111)	
FM 24-32	TAC Tele Sys Planning, Eng, Integration and Control	
FM 24-999	Cryptologistics Spt to the Army in the Field	
FM 32-30	EW, Tactics of Defense	
TC 11-999E	Camouflage of Signal Sites	
TC 11-999G	Airborne Radio Relay	
TC 11-999H	Unit Level Switching	
TC 24-1	The CEOI	
TC 24-3	Radio Wire Integration	
TC 24-18	Commo in "The Come As You Are War"	
TC 32-11	How to get out of a Jam	
	SOLDIER SUPPORT CENTER	
FM 12-3-1	Company/Bn Level P&A Doctrine	
FM 12-3-2	DIV/SEP Bde Level P&A Doc	
FM 12-3-3	CORPS Level P&A Doc	
FM 12-3-4	EAC P&A Doc	
FM 12-15	Wartime Casualty Reporting Sys	
FM 12-16	Replacement Ops	
FM 14-6	Comptroller/Finance Svc in T.O.	
FM 14-7	Financial Services	
FM 22-999A	Unit Cohesion	
FM 22-999B	Human Performance in Continuous Ops	
FM 26-999A	Mgt of Stress in Army Ops	

TABLE 1-4

DOCTRINAL LITERATURE PROGRAM PUBLICATIONS AND PROPONENTS (continued)

Publications	Title	Remarks
	TRANSPORTATION SCHOOL	
FM (J) 20-12	Amphib Embarkation	TRADOC Approved
FM 29-39	Marine Equip Maintenance Mgt	
FM 55-1	Army Trans Svc in T.O.	
FM 55-2	Div Trans Ops	
FM 55-10	Army Movement Mgt Units and Procedures	
FM (J) 55-12	Movement of Army Units in AF Aircraft	TRADOC Approved
FM (J) 55-19	Spt of Contingency Forces	
FM 55-20	Army Railway Units and Ops	
FM 55-30	Army Motor Transport Units and Ops	
FM 55-40	Cbt Svc Spt Air Transport Ops	
FM 55-41	Aircraft Org Maintenance Mgt	
FM 55-42	Army Aviation Intermediate Maintenance (AVIM)	
FM 55-45	Aviation Spt Bn	
FM 55-50	Army Water Transport Ops	
FM 55-60	Army Terminal Ops	
FM 55-999B	LACV-30 Units and Ops	

1.1.4 Document Data

Relevant data collected in this procedure must be entered into the SDT. This data should be entered into the SDT immediately after the worksheets contained in Figure 1-2, 1-3, and 1-4 are completed. Table 1-5 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT is provided in the SDT User's Guide.

1.2 IDENTIFY SYSTEM PERFORMANCE MEASURES AND GOALS

OVERVIEW

Once system functions have been defined, system performance measures and goals and system organizational, operational, and support concepts must be identified. These data elements help to further define the functional requirements of the New system.

Many new concepts and terms (for example, performance measure, performance goal) are introduced in this procedure. The reader should examine the definitions of key terms which are listed in Table 1-6 before beginning this procedure.

PROCEDURE

An overview of the steps in this procedure is presented in Figure 1-5.

Table 1-5. Guidelines for Entering Data Into SDT.

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.1	Function Name	Function	PRF	(b)	1
1.1	Function Number	Function	PRF	(a)	1
1.1	Mission Name	Mission	MIS	(a)	2
1.1	Percent Operating Time	Mission	MIS	(g)	2
1.1	Annual # of Missions	Mission	MIS	(h)	2
1.1	Annual Operating Days	Mission	MIS	(i)	2
1.1	Mean Duration	Mission	MIS	(j)	2
1.1	Operating Requirements	Mission	MIS	(k)	2
1.1	Collective Task	Function	-	-	3 (opt.)
1.1	Mission Impact Variable	Function	MIS	(d)	2
1.1	Functions Impacted by Mission	Function	MIS	(e)	2
1.1	Reference for Mission Impacts	Function	MIS	-	2 (opt.)

opt. = optional

Table 1-6. Definition of Key Concepts

- System Performance Measures - A listing of the measures which are used to describe the performance capabilities which must be achieved by each system function. These measures are usually described in the program documentation (e.g., speed might be measured in miles per hour (MPH) or kilometers per hour (KPH)).

- System Performance Goals - A description of the goals (or requirements) which must be achieved for each performance measure. Goals may be stated in general terms (e.g., increase by 10%) or as specific quantitative values (e.g., the exact goal is listed-50 MPH or 30.8 KPH).

- Organizational Concept - A general textual description of the way in which the new system will be manned (in strictly an organizational sense) and the way in which it will fit into existing Army organizational structures.

- Operational Concept - A general textual description of the doctrinal (how to fight) concepts that will guide the operation of the system in both wartime and peacetime and a description of how the system will fit into more general concepts.

- Operational Environment - A textual description of the specific environment, geographic, and threat conditions which the projected system will encounter.

- Support Concepts - A general description of how and where each individual Integrated Logistics Support Concept should be performed and which Army organizations will perform these elements. As outlined in DoDD 5000.39, the elements of ILS are (1) maintenance, (2) manpower and personnel, (3) supply support, (4) support and test equipment, (5) training and training devices, (6) technical data, (7) computer resources, (8) packaging, handling, storage, and transportation, and (9) facilities.

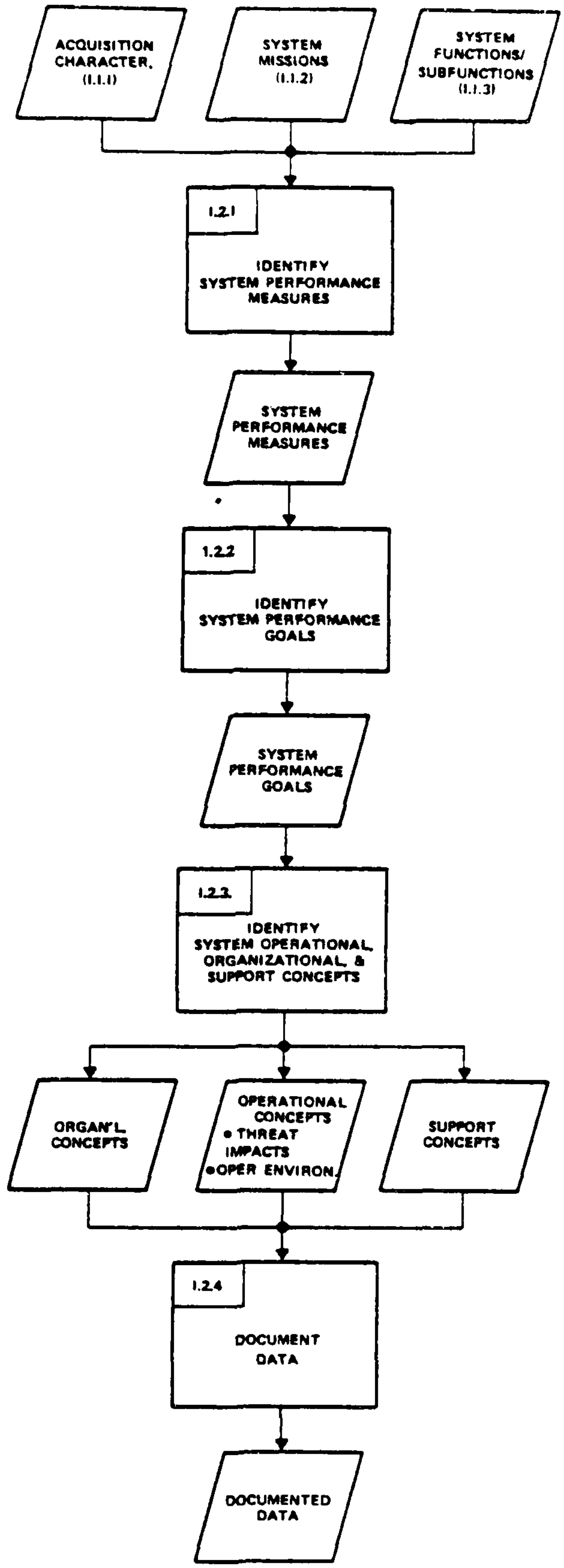

FIGURE 1-5. Overview Diagram: Identify System Performance Measures and Goals (1.2).

1.2.1 Identify System Performance Measures

You may identify potential performance measures by examining the program documentation (for example, the JSMNS) collected in Procedure 1.1.1. Any measure describing the potential performance capabilities of the system should be treated as a potential performance measure. To aid the user, a list of common performance measures is presented in Appendix F. Examine the list of system functions identified in Procedure 1.1.3 and identify the performance measures associated with each function. Enter the description of each performance measure in Column C of the System Performance Specifications Worksheet (PRF) contained in Figure 1-6. (Columns a and b of this worksheet, describing system functions should have been completed in Procedure 1.1.3.) Each function may (1) have more than one performance measure associated with it or (2) not have any associated performance requirements and therefore have no performance measures.

1.2.2 Identify System Performance Goals

Examine the program documentation collected during procedure 1.1.1 and identify the quantitative goals and standards associated with each of the performance measures identified in Procedure 1.2.1. Enter the data in Column (d) of the PRF Worksheet listed in Figure 1-6. A goal may be stated in general terms (for example, increase 10%) or in terms of specific quantitative values (for example, fire 200 rounds per minute). Each performance measure should have at least one goal.

Figure 1-6 System Performance Specification Worksheet (PRF)

Worksheet # ________

System DSWS

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum
	MIS W/S, Table 1-4					
1.0	Shoot	target servicing rate (tgts/hr) rate of fire (rpm-rounds per minute)	35-40 tgts/hour sustained rate, automatic, 8-12 rpm sustained rate, manual, ≥ 4 rpm			
		range (km)	max (assisted), ≥ 30 km max (unassisted) 20-25 km minimum (high angle), 3-5 km direct fire, .1-2.5 km			
		accuracy	guided round, 1-10 ft. range error (non-RAP), .25-.20% of range range error (RAP), .35-.30% of range azimuth error, .5-1 mil			
1.1	Load Weapon	inventory control/monitoring	automatic	x		x
1.2	Aim Weapon	pointing accuracy	.3-.5 mils	x	x	x
1.3	Arm the Weapon			x		x
1.4	Launch Weapon			x		

Figure 1-6 System Performance Specification Worksheet (PRF) (Continued)

Worksheet # ______

System DSWS

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum
	MIS W/S, Table 1-4					
2.0	Navigate					
2.1	Determine Position	Location accuracy	15-20 meter radius	x		
		Altitude accuracy	2-10 meter			
		Attitude accuracy	1.0 mil			
2.2	Determine Destination					x
2.3	Determine Route					x
3.0	Move					
3.1	Displace Weapon	Displacement Time	0-30 seconds			x
3.2	Relocate Weapon	Speed (KPH)	Primary Roads, 60-75	x		x
			Secondary Roads, 40-45			
			Trails, 25-30			
			Cross Country, 15-20			
			10% Grade, 40			

Figure 1-6 System Performance Specification Worksheet (PRF) (Continued)

System DSWS

Worksheet # ________

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Human
	MIS W/S, Table 1-4					
3.2	Relocate Weapon (cont'd)	Night Vision Degrade	10%			
		HP/ton	18-22			
		Cruising Range (Km)	400-600 km			
		Slope % Capability	Ascending 60% Side 40%			
		Obstacle Crossing Capability	Vertical 21-36 in. Trench 72-96 in. Fording Depth 42-46 in.			
3.3	Emplace Weapon	Emplacement Time	< 60 seconds			
4.0	Perform Support Services					
4.1	Provide Maintenance Support	MTBF MTBCMA MTTR	Specified for each major subsystem 0.5 hr			
4.2	Provide Supply Support					

1.2.3 Identify Operational, Organizational, and Support Concepts

Information on the organizational concept, operational concept, and operational environment should be available in the program documentation collected during Procedure 1.1.1. However, support concepts for many of the elements of ILS are likely to be unavailable during the early phases of the acquisition process. If the operational and support concepts are unavailable, the user should obtain and use the operational and support concepts for the predecessor or another similar system. These concepts should then be modified to reflect the demands of the new system, subject to coordination with, and verification by, personnel from the Program Management Office (PMO). Organizational, Operational and Support Concept data is recorded on an Organizational, Operational and Support Concept Worksheet (OSC), Figure 1-7. As the examples in Figure 1-7 indicate, the organizational, operational, and support concepts consist of a combination of brief textual descriptions and quantitative estimates of usage.

To further document system functional requirements the user may use the worksheet listed in Figure 1-8, which briefly describes the impact of the threat and the operational environment on system functions. This information is optional. However, some users find it helpful in developing descriptions of task conditions and standards for use in Training and Soldiers Manuals. Information in system threat and operational environment impacts may be obtained from (1) SCORES, which contains general descriptions of threats and scenarios, (2) the threat analyses conducted during system development, and (3) the program documentation collected during Procedure 1.1.

Figure 1-7 Organizational, Operational and Support Concepts Worksheet (OSC)

System DSWS　　Worksheet # ______　　*SDT Input/Output

Procedure 1.2

M109 Howitzer System

Operational Concept

Three Vehicles:
- M109 Howitzer
- Resupply Vehicle - RV
- Field Maintenance Vehicle - FMV

PRESENT OPERATIONAL CHARACTERISTICS

Vehicle	Operational Mode	Sustained	Intense	Surge
M109 Howitzer	MOBILITY			
	Moves/Day	2	3	4
	Miles/Move (Avg)	2.4	2.2	1.7
	FI.. MISSIONS			
	Missions/Day	20	32	48
	Rounds/Mission (Avg)	6	8	8
	COMMUNICATIONS			
	On Time/Day (Hours)	24	24	24
	Transmit Time/Day (Hours)	3	6	6
	Receive Time/Day (Hours)	24	24	24
RV	MOBILITY			
	Moves/Day	8	16	25
	Miles/Move (A.g)	12	12	12
	AMMO TRANSFER			
	Transfers/Day	8	16	25
	Rounds/Transfer	30	30	30
	COMMUNICATIONS			
	On Time/Day (Hours)	24	24	24
	Transmit Time/Day (Hours)	8	16	18
	Receive Time/Day (Hours)	24	24	24

New System

Operational Concept

Four Vehicles Planned:
- Self-Propelled Howitzer - SPH
- Battery Operations Center Vehicle - BOCV
- Ammunition Resupply Vehicle - ARV
- Armored Maintenance Vehicle - AMV

SPH battlefield intensity levels are sustained, intense and surge.

OPERATIONAL CONCEPT

Vehicle	Operational Mode	Sustained	Intense	Surge
SPH	MOBILITY			
	Moves/Day	7	13	12
	Miles/Move (Avg)	1.5	).2	1.1
	FIRE MISSIONS			
	Missions/Day	50	88	118
	Rounds/Mission (Avg)	4.	4.25	4.25
	COMMUNICATIONS			
	On Time/Day (Hours)	24	24	24
	Transmit Time/Day (Hours)	2	4	4.5
	Receive Time/Day (Hours)	4	8	10
ARV	MOBILITY			
	Moves/Day	Varies*	Varies*	Varies*
	Miles/Move (Avg)	15.53	15.53	15.53
	AMMO TRANSFER			
	Transfers/Day	Varies*	Varies*	Varies*
	Rounds/Transfer	"	"	"
	COMMUNICATIONS			
	On Time/Day (Hours)	24	24	24
	Transmit Time/Day (Hours)	1	3	4
	Receive Time/Day (Hours)	4	8	10

* Depends upon storage capacity

Figure 1-7 Organizational, Operational and Support Concepts Worksheet (OSC) (Continued)

System DSWS

Worksheet # ____

*SDT Input/Output

Procedure 1.2	
M109 Howitzer System	New System
Operational Concept (continued)	Operational Concept (continued)
	BOCV required for easier coordination of increased fire missions.
Ammunition resupply involves manual transfer of rounds and projectiles from RV to M109.	Ammunition resupply to be automated or at least utilize materiel handling tools to speed the process. Any required operators must be provided an NBC protective environment.
NBC environment benign	NBC environment potentially hostile.
Primary fire categories: (1) Target Engagement 80-90% (2) Counterfire 10-20%	Primary fire categories: (1) Target Engagement 75-80% (2) Counterfire 10-15% (3) Air Defense Supression 5-10% (4) Interdiction/Deep Fires 1-5%

Figure 1-8 Operational Environment Worksheet (ENV)

System DSWS

*SDT Input/Output

Procedure 1.2							
System Threat Impacts				Operational Environment Impacts			
Threat Characteristics (a)	Threat Variables Impacting Functions* (b)	Function Variables Impacted by Threat* (c)	Reference* (d)	Operational Environment Characteristics (e)	Environmental Variables Impacting Functions* (f)	Function Variable Impacted by Environment* (g)	Reference* (h)
U.S. Forces outnumbered enemy tactics will employ deep second echelons for reinforcing front line units	Target Density	Shoot Move Utilize Intelligence Command and Control	DARCOM publication Threat Description Threat Organizatio Tactics and Equip. JMSNS Battlefield Development Plan	battlefield terrain may vary from desert to field and forest to arctic Various terrains will include obstacles which may either be gone over, under, around or may be impassable	Terrain	Move Navigate Provide Benign Environment (for personnel)	JMSNS Battlefield Development Plan
enemy focus will have NBC weapons available for use in a sustained conflict	NBC Environment	Provide Benign Environment (for personnel	same	terrain may lack navigation references		Perform Support Services	

1.2.4 Document Data

Relevant data collected during Procedure 1.2 must be entered into the SDT. This data should be entered into the SDT immediately after the worksheets listed in Procedures 1.2.1 to 1.2.3 have been completed. Table 1-7 describes the most desirable order for entering data into the SDT. Additional guidelines for entering data into the SDT is provided in the SDT User Guide.

1.3 ALLOCATE REQUIRED SYSTEM FUNCTIONS AND IDENTIFY LOWER LEVEL FUNCTIONS

OVERVIEW

This procedure is designed to allocate system functions in Procedure 1.2 to people, equipment, and software based on the allocation of functions in the predecessor and other comparable existing systems. This information is used to develop a generic equipment structure and to identify lower level functions and place them in a hierarchy.

PROCEDURE

An overview of the steps comprising this procedure is depicted in Figure 1-9.

1.3.1 Allocate Major System Functions/Subfunctions

In this step, you must allocate the functions identified in Procedure 1.2 to people, software, and equipment (or some combination thereof). High level functions can be allocated to people, hardware, and software by (a) examining how

TABLE 1-7. GUIDELINES FOR ENTERING DATA INTO SDT

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.2	Performance Measure	Function	PRF	(c)	1
1.2	Performance Goal/Standard	Function	PRF	(d)	1
1.2	Threat Variable	Function	ENV	(b)	2 (opt.)
1.2	Function Variables Impacted by Threat	Function	ENV	(c)	2 (opt.)
1.2	Reference for Threat Impact Description	Function	ENV	(d)	2 (opt.)
1.2	Environmental Variable	Function	ENV	(f)	3 (opt.)
1.2	Function Variables Impacted by Threat	Function	ENV	(g)	3 (opt.)
1.2	Reference for Environmental Impact Description	Function	ENV	(h)	3 (opt.)
					opt = optional

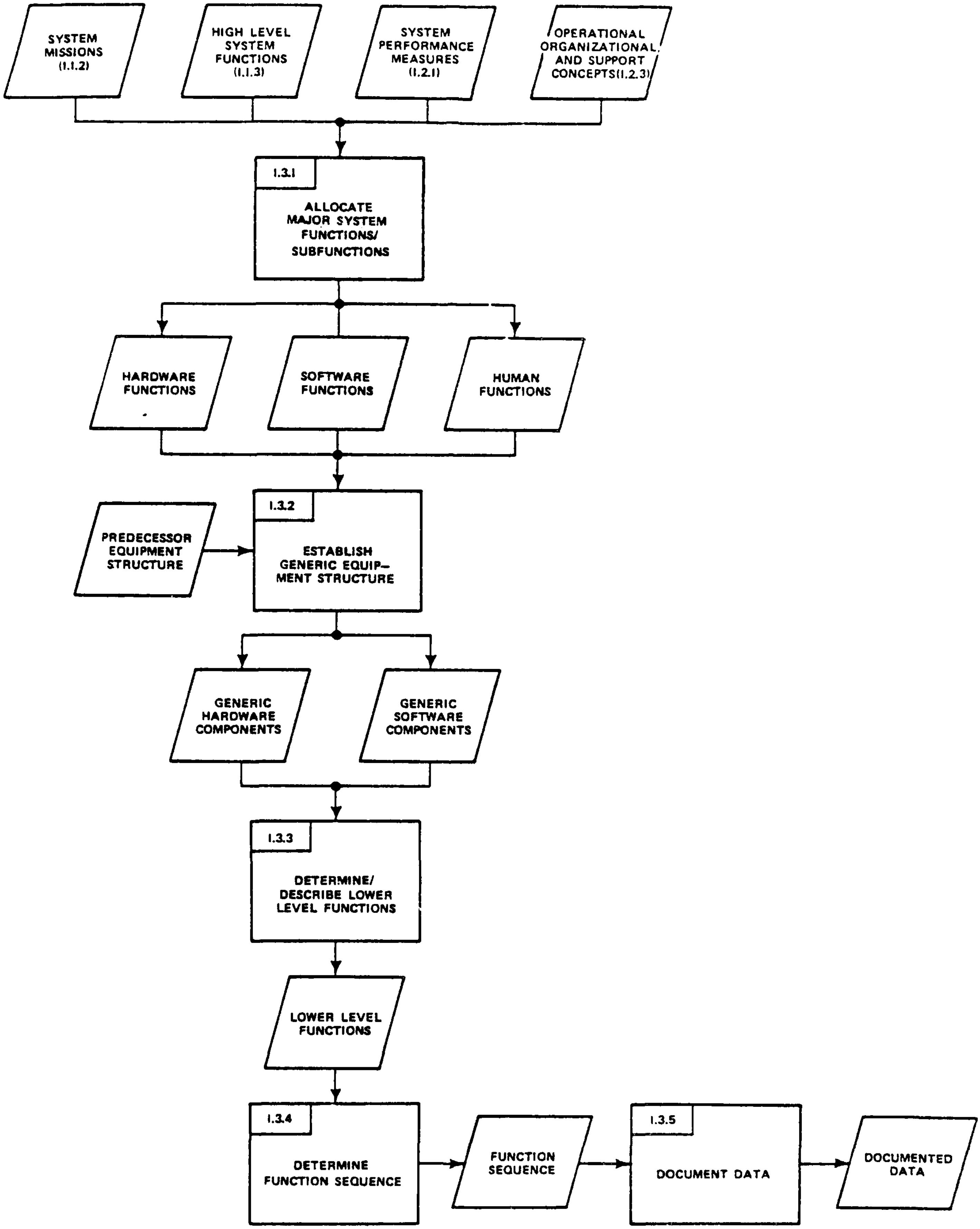

FIGURE 1- 9. Overview Diagram: Allocate Required System Functions and Identify Lower Level Functions (1.3)

similar functions were allocated in the predecessor system or other similar systems, and (b) updating these allocations to account for the performance goals associated with the New system.

Once identified the allocations should be entered in the last three columns of the System Performance Specification Worksheet (PRF) shown in Figure 1-10.

1.3.2 Establish Generic Equipment Structure

A generic equipment structure describes the generic equipment subsystems (e.g., engine) which must be included in the New system. A example of a generic equipment structure is provided in Table 1-8. The generic equipment structure can be developed by (a) examining the equipments in the predecessor system, (b) adding equipments to achieve the additional capabilities required by the New system, and (c) deleting equipments which are not needed in the New system (as indicated by the New system functional requirements and functional allocation).

The generic equipment structure for the predecessor system can be identified by examining the maintenance manuals associated with the system. To identify the generic equipments which must be added or deleted from the predecessor, present the predecessor equipment list and function allocations along with information on the system functional requirements to subject matter experts from the schools associated with the predecessor system and ask them to make the proper modifications to the predecessor equipment list.

Figure 1-10 System Performance Specification Worksheet (PRF)

Worksheet # ________

System DSWS

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum
	MIS W/S, Table 1-4					
1.0	Shoot	target servicing rate (tgts/hr) rate of fire (rpm-rounds per minute) range (km) accuracy	35-40 tgts/hour sustained rate, automatic, 8-12 rpm sustained rate, manual, ≥ 4 rpm max (assisted), ≥ 30 km max (unassisted) 20-25 km minimum (high angle), 3-5 km direct fire, .1-2.5 km guided round, 1-10 ft. range error (non-RAP), .25-.20% of range range error (RAP), .35-.30% of range azimuth error, .5-1 mil			
1.1	Load Weapon	inventory control/monitoring	automatic	x		x
1.2	Aim Weapon	pointing accuracy	.3-.5 mils	x	x	x
1.3	Arm the Weapon			x		x
1.4	Launch Weapon			x		

Figure 1-10 System Performance Specification Worksheet (PRF) (continued)

Worksheet # ________

System DSWS

*SDT Input/Output

Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing		System Performance Measure* (c)	System Performance Goals* (d)	Functional Allocation (e)		
Function Number* (a)	Function Name* (b)			H/W	S/W	Hum.
	MIS W/S, Table 1-4					
2.0	Navigate					
2.1	Determine Position	Location accuracy Altitude accuracy Attitude accuracy	15-20 meter radius 2-10 meter 1.0 mil	X		
2.2	Determine Destination*					X
2.3	Determine Route					X
3.0	Move					
3.1	Displace Weapon	Displacement Time	0-30 seconds			X
3.2	Relocate Weapon	Speed (KPH)	Primary Roads, 60-75 Secondary Roads, 40-45 Trails, 25-30 Cross Country, 15-20 10% Grade, 40	X		X

Figure 1-10 System Performance Specification Worksheet (PRF) (Continued)

System DSWS

Worksheet # ______

*SDT Input/Output

Function Number* (a)	Function Name* (b)	System Performance Measure* (c)	System Performance Goals* (d)	H/W	S/W	Human
Procedure 1.1		Procedure 1.2		1.3		
New System						
Hierarchical Functional Listing				Functional Allocation (e)		
	MIS W/S, Table 1-4					
3.2	Relocate Weapon (cont'd)	Night Vision Degrade	10%			
		HP/ton	18-22			
		Cruising Range (Km)	400-600 km			
		Slope % Capability	Ascending 60% Side 40%			
		Obstacle Crossing Capability	Vertical 21-36 in. Trench 72-96 in. Fording Depth 42-46 in.			
3.3	Emplace Weapon	Emplacement Time	< 60 seconds			
4.0	Perform Support Services					
4.1	Provide Maintenance Support	MTBF MTBCMA MTTR	Specified for each major subsystem 0.5 hr			
4.2	Provide Supply Support					

Table 1-8. Generic Equipment Structure.

System: Trainer Aircraft System

Generic Equipment No.	Equipment
11000	Airframe
12000	Fuselage
13000	Landing Gear
14000	Flight Controls
24000	Auxiliary Power Plant
27000	Turbo Fan Engines
29000	Power Plant Installation
41000	Air Cond/Press/Ice Control
42000	Electrical System
44000	Lighting Systems
45000	Hydraulic/Pneumatic Power
46000	Fuel System
47000	Oxygen Systems
49000	Miscellaneous Utilities
51000	Instruments
56000	Flight Reference
58000	Inflight Test Equipment
62000	VHF Communications
63000	UHF Communications
64000	Interphone
65000	IFF Systems
66000	Emergency Radio
71000	Radio Navigation
72000	Radar Navigation
74000	Weapons Control
75000	Weapons Delivery
91000	Emergency Equipment
96000	Personnel Equipment
97000	Explosive Devices

Once the generic equipment structure has been identified it should be documented in the Generic System Worksheet (GEN). Columns (a) and (b) of the worksheet should list the number and title of the system functions as described in columns (a) and (b) of the PRF worksheet. Column (c) of the GEN worksheet should be used to describe the generic equipment structure.

Once the generic equipment has been identified at the subsystem level, lower level equipments must be identified and the resulting lower level functions must be described. Information on lower level functions should be entered into columns (a) and (b) of the GEN and PRF worksheets. Information on generic equipment should be entered into column (c) of the GEN worksheet.

As part of the identification of generic equipment, you must allocate functions to hardware, software, or humans. These allocations should be documented in column (e) of the PRF worksheet and columns (d), (e), and (f) of the GEN worksheet. In the GEN worksheet (column f), functions allocated to humans are further broken down by classifying these functions as (a) generic operator functions, (b) generic maintenance functions, or (c) generic support functions.

1.3.3 Determine/Describe Lower Level Functions

Subsystem level functions are identified in the same way as high-level functions. Lower level functions from the predecessor or other comparable systems are identified and modified to reflect the New system requirements. Information on the predecessor and other comparable equipments is contained in the Generic System Worksheet (Figure 1-11).

Figure 1-11 Generic System Worksheet (GEN) (Continued)

System DSWS

*SDT Input/Output

Procedure 1.3

	New System	Generic System					
			Functional Allocation				
					Human		
Function Number*	Generic Equipment Name*	Generic Equipment Name	H/W	S/W	O	S	M
PRF W/S		Table 1-5					
4.1(cont'd	Maintain the Traversing Mech., auto						X
	" " " " , manual						X
	" " Elevating " , auto						X
	" " " , manual						X
	" " Fuze Setting Mech.						X
	" " Priming Mechanism						X
	" " Firing Mechanism						X
	" " Firing Circuit						X
	" " Firing pin/lanyard						X
	" " Recoil/counter-recoil						X
	Perform Pre-fire checks				X		X
	Perform Post-fire checks/maintenance						X
4.2	Supply Spare Parts and Consumables	Spare Parts and Consumables				X	X
	Resupply Ammunition				X	X	
	Record/Report Ammunition Expenditures					X	

Figure 1-11 Generic System Worksheet (GEN) (Continued)

System DSWS

*SDT Input/Output

Procedure 1.3

New System	New System	Generic System					
			Functional Allocation				
					Human		
Function Number*	Function Name	Generic Equipment Name	H/W	S/W	O	S	M
(a)	(b)	(c)	(d)	(e)	(f)	(f)	(f)
1.3	Set Fuze	Projectile Fuze	X		X		
		Fuze Setting Mechanism					
	Prime the propellant charge	Priming Mechanism	X		X		
1.4		Primers					
	Fire Gun	Firing Mechanism	X		X		
	Absorb the recoil force	Firing Circuit	X				
	Restore the gun to battery	Firing pin/lanyard	X				
4.0		Recoil/counter-recoil mechanism					
4.1	Maintain the Gun	Test Equipment					X
	Maintain the Projectile Magazine	Maintenance Support					X
	" " Propellant "	Documentation					X
	" " Loading Tray						X
	" " Breech/Breech Mech.	Maintenance Tools and Supplies					X
	" " Rammer						X
	" " Gun Tube						X

Figure 1-11 Generic System Worksheet (GEN)

System DSWS Worksheet # ______ *SDT Input/Output

Procedure 1.3

New System		Generic System					
Function Number*	Function Name	Generic Equipment Name	Functional Allocation				
			H/W	S/W	Human O	Human S	Human M
(a)	(b)	(c)	(d)	(e)	(f)	(f)	(f)
1.0	Shoot the Gun	Gun	X		X		
1.1	store the projectile in magazine	Projectile	X				
	extract projectile from magazine	Projectile Magazine	X		X		
	transfer projectile to loading tray	Loading Tray	X		X		
	store the propellant in magazine	Propellant	X				
	extract propellant from magazine	Propellant Magazine	X		X		
	transfer propellant to loading tray	Loading Tray	X		X		
	open breech	Breech/Breech Mechanism, Auto	X		X		
1.2	ram projectile/propellant into tube	Rammer	X		X		
	close breach	Gun Tube	X		X		
	traverse gun tube, auto	Traversing Mechanism, Auto	X				
	" " " manually	"" "" Manual			X		
	elevate gun tube, auto	Elevating mechanism, Auto	X				
	" " " manually	"" "" Manual			X		

1.3.4 Describe Function Sequence

Identification of function sequence is accomplished by identifying function sequences from the predecessor or other comparable existing systems and then modifying these sequences to reflect the New system operational concept and functional requirements. Function sequence information describes (a) what functions must be performed prior to, after, or concurrently with a given function during mission performance. The best sources for this function sequence information are the doctrinal manuals (e.g., the How-to-Fight manuals and ARTEPS) associated with the existing systems.

A worksheet which can be used to describe function sequence is contained in Figure 1-12. Identification of function sequences can be facilitated by drawing a function sequence diagram such as that contained in Figure 1-13, which contains a high level function sequence diagram. A preceding function is a function which must be performed before the designated function. A succeeding function is a function which must be performed after the designated function. A concurrent function is a function which must be performed at the same time as the designated function.

Whenever comparability analysis procedures are employed during system function requirements identification, the comparable existing systems and the modification to these systems should be included in the audit trail. In addition, all information on functional requirements generated via comparability analysis should be presented to the Program Office/Combat Developments Directorate for review and ultimate approval.

Figure 1-12. Function Sequence Worksheet (FSQ)

System ________ Worksheet # ________ # ________ of ________

Procedure 1.3							
Function # (a)	Function Name (b)	Preceding Functions		Succeeding Functions		Concurrent Functions	
		# (c)	Name (d)	# (e)	Name (f)	# (g)	Name (h)

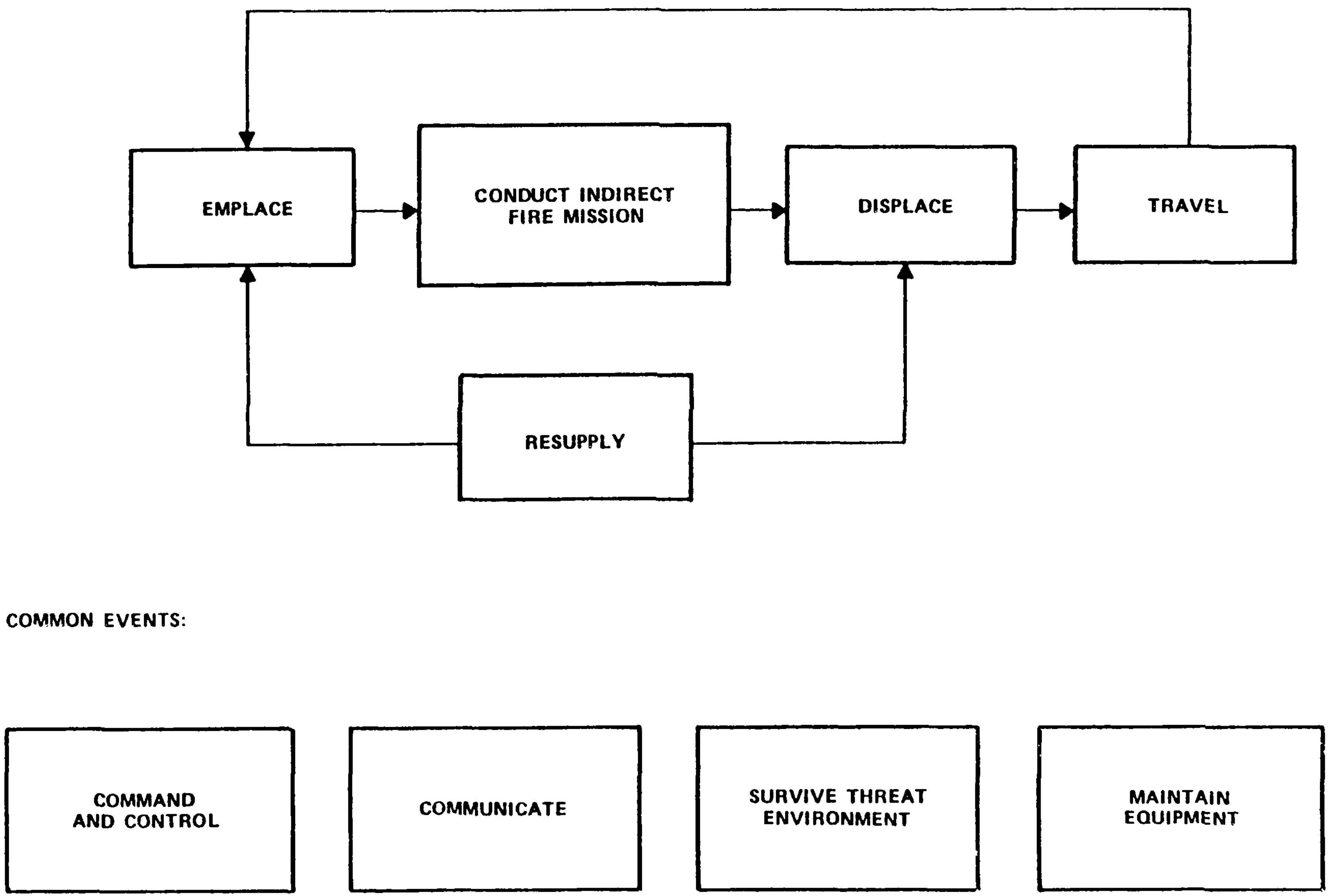

FIGURE 1-13. Function Sequence Diagram

1.3.5 Document Data

Relevant data collected in this procedure must be entered into the SDT. This data should be entered into the SDT immediately after the worksheets contained in Figures 1-10, 1-11, and 1-13 are completed. Table 1-9 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide.

1.4 ESTABLISH THE BASELINE COMPARISON SYSTEM (BCS)

OVERVIEW

The BCS is a notional design consisting of the existing subsystems which currently come closest to meeting the functional requirements of the New system. Since the BCS only contains existing subsystems, the BCS may not meet all of the performance goals established for the New system.

In order to be selected for the BCS, a subsystem must meet the following criteria: (1) it must be an existing subsystem currently in the DoD inventory, preferably in the Army inventory, (2) it must be the existing subsystem which most closely matches system performance requirements, and (3) it must have mature task data. The latter set of data is critical for training requirements determination.

PROCEDURE

An overview of procedure 1.4 is contained in Figure 1-14.

TABLE 1-9. GUIDELINES FOR ENTERING DATA INTO SDT

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.3	Lower Level Function Names	Function	PRF	(b)	1
1.3	Lower Level Function Number	Function	PRF	(a)	1
1.3	Generic Equipment Name	Equipment	GEN	(c)	2
1.3	Preceding Functions - #	Function	FSQ	(c)	3 (opt.)
1.3	Succeeding Functions - #	Function	FSQ	(e)	3 (opt.)
1.3	Concurrent Functions - #	Function	FSQ	(g)	3 (opt.)
					opt = optional

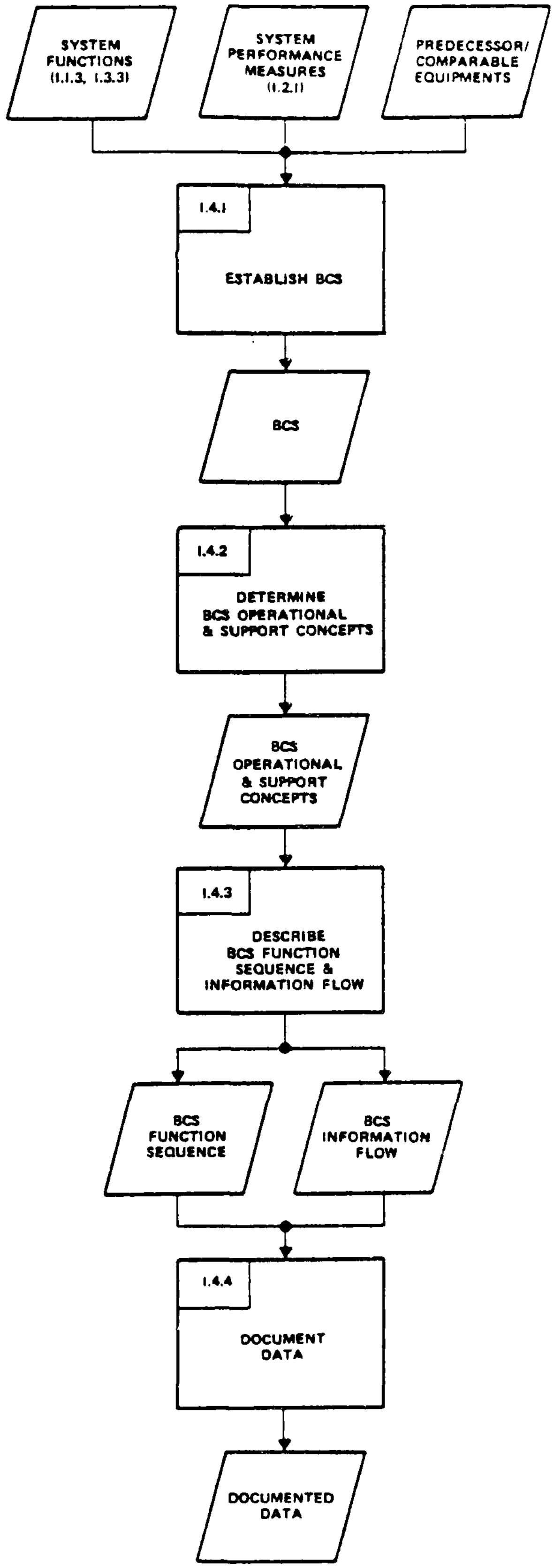

FIGURE 1-14. Overview Diagram: Establish Baseline Comparison System (BCS).

1.4.1 Establish The Baseline Comparison System (BCS)

This step is initiated with the construction of a BCS equipment list. The BCS is comprised of comparable existing subsystems (predecessor or other) from the Army inventory which (a) best meets the functional and performance requirements of the New system and (b) have mature task data.

A worksheet for describing the BCS equipments is presented in Figure 1-15. New system functions and performance goals are listed in columns (a) and (b). This information can be taken from the System Performance Specification Worksheets developed in procedures 1.1 through 1.3 (See Figures 1-4, 1-6, and 1-10).

Second, generic equipments identified in Procedure 1.3.2 and listed in Figure 1-11 (Generic System Worksheet) are entered in Columns (c) and (d). These generic equipments designate the type of existing equipment to be considered for the BCS.

Once columns (a) thru (d) have been completed, the worksheet should be presented to subject matter experts from the functional areas associated with each major subsystem in the generic equipment structure. These analysts should be asked to indicate what equipments in the predecessor or other comparable system can (1) best meet the New system performance requirements, (2) has available mature reliability, availability, maintainability (RAM), workload, training and other data, and (3) where design information for the new system exists, has technology as similar as possible to that projected for the New system. Additional guidance for the

Figure 1-15 Baseline Comparison Equipment Selection Worksheet (BCS)

System DSWS

Worksheet # ______

*SDT Input/Output

Procedure 1.4

New System		Generic System		BCS Candidate Equipments																	
		Equipment Structure						Historical RAM/ Task Data Availability											Optional	
									Task Time			Task Freq								
Function Number(s)*	System Performance Goals/Measures	Number	Name	Equipment Number*	Name	Service/ Other Inventory	Perf. Match Rank	Task Descr.	Elapsed	Total	Allow	Prevent	Inherent	Induced	Maint. Level	MOS/SL	• Selected	FGC WBC WUC •	Mfg's P/N •
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)									(j)	(k)	(l)
1.0	Sustained Fire, auto, 8-12 rpm	1909.1	Rammer	1909	M109A2 Projectile Rammer	Army	3	X		X	X	X			X	X	X	1909	
1.1	Sustained Fire, manual ≥ 4 rpm				MK45 MOD Ø Lightweight Gun Mount (LWGM) Rammer	Navy	3	X	X	X		X	X	X		X			
1.3	ammunition inventory capacity - 55 rounds	1912.1	Projectile Mag.	1912/ 3401/ 3403	M109A2 Howitzer Loading Sys.	Army	3	X		X	X	X			X	X		1912/ 3401/ 3403	
	automatic inventory control/ monitoring	.2	Propellant Mag.		M60 Loading System	Army	4	X		X	X	X			X	X			
		.3	Loading Tray		Vertical Load Gun Mount (VLGM)	Navy (under devel)	2												
					MK45 MOD Ø LWGM Autoloader	Navy	2	X	X	X		X	X	X		X	X		
1.0	sustained fire, auto, 8-12 rpm	3401.1	Gun Tube	3401															
1.1		.2	Recoil/Counter recoil mech.																
1.3	sustained fire, manual, ≥ 4 rpm	.3	Breech/Breech mechanism																
		.4	Firing mech.																
		.5	Firing circuit																
		.6	Firing pin/ lanyard																
		.7	Priming mech.																
		3403.1	Fuze Setting mechanism	3403															

identification of BCS equipments can be provided by examining existing equipment taxonomies in the functional areas associated with the New system. Equipment taxonomies list the specific equipments associated with each category in the generic equipment structure. Such taxonomies are likely to be found in configuration or logistics management directories associated with the New system functional area. Table 1-10 presents an example page from the equipment taxonomy which is included in the Aviation Electronics Configuration Directory.

Once potential BCS equipments have been identified, the subject matter experts should be asked to note the degree to which each potential BCS subsystem matches the performance requirements of the New system on a one to seven scale (one-not all and seven-identical). One rating should be obtained for each potential BCS equipment. These ratings should be entered in column (h) of the BCS worksheet. Column (i) of this worksheet should be used to document the availability of BCS data. Columns (k) and (l) may be used to describe the Functional Group Code (FGC) Work Breakdown Code (WBC), Work Unit Code (WUC), or Manufacturer's Part Number (MFG's P/N) of the selected BCS equipments.

After the BCS equipment list has been constructed, detailed data on the BCS equipment may be obtained. Some of this information may be obtained during the manpower requirements analysis. The BCS Equipment Description Worksheet contained in Figure 1-16, should be used to document this data. The major focus should be on the identification of equipment characteristics which are directly related to task identification and analysis. However, additional equipment characteristics may also be identified and included in the

TABLE 1-10. EXAMPLE OF EQUIPMENT TAXONOMY.

Specific Equipment	Generic Equipment	NSN	LIN	RIC	LCC	Price	Fund	Basic comp or end item	Replaced by (RB) or replaces (RS)	Commercial equivalent
AN/APM-196A	Test Set, Recorder-Processor Viewer	6625-00-089-9657	V84003	B16	N	7000.00	P	SM-346/APM-196		Motorola #01 2876A01
AN/APM-214	Alignment Fixture, Recorder	6625-00-013-6934		B16	N	11,986.00	S			Motorola #01-28211C01
AN/APM-239A	Test Set, Transponder	6625-00-802-7425	V99416	B16	B	3000.00	P			Hazeltine #119065
AN/APM-245A	Test Set, Simulator, Interrogator Transponder	6625-00-164-6551	V92715	B16	U	850.00	P			
AN/APM-246	Test Set, Radar	6625-00-943-2059	V83667	B16	A	10,300.00	P		RS AN/APM-209	Collins #522-5729-014
AN/APM-247	Test Set, Radar	6625-00-908-9577	V83668	B16	A	5251.85	P	TS-2081/APM-245	RS AN/APM-209	Collins #522 5731-015
AN/APM-270(V)1	Test Facilities Transponder	6625-00-888-4589	V61654	B16	A	4200.00	P			Packard Bel Elct #BTA-123
AN/APM-305	Test Set Transponder	6625-00-179-1532	V99436	B16	U	6500.00	P			
AN/APM-322	Test Set, Radar Altimeter Module	6625-00-437-7312	V86006	B16	A	3800.00	P			Honeywell #1995940-1
AN/APM-323	Test Set, Radar Altimeter System	6625-00-491-0580	V86011	B16	A	8850.00	P			Honeywell #1995950-1
AN/APM-338	Test Transponder	6625-00-423-6617		B16						
AN/ARM-5	Test Set Radio	6625-00-669-0272	V86383	B16	A	904.00	P	SG-66/ARM-5		Aircraft Radio Corp #15009
AN/ARM-5A	Test Set, Radio	6625-00-926-7768	V86383	B16	A	2115.00	P	SG-66B/ARM-5		Acft Radio Corp #H-14A
AN/ARM-8	Test Set, Radio	6625-00-628-1262	V86520	B16	B	492.00	P			Bendix #06845
AN/ARM-22	Test Set, Radio	6625-00-523-4291	V86588	B16	B	16,000.00	P			
AN/ARM-22A	Test Set, Radio	6625-00-930-9920	V86588	B16	B	16,000.00	P			General Dynamics #666097-804
AN/ARM-31	Test Set, Indicator	6625-00-580-8142	V80012	B16	B	8141.00	P			
AN/ARM-31A	Test Set, Indicator	6625-00-179-7719	V80012	B16	B	9000.00	P			Stromberg #666096-010
AN/ARM-45	Test Set, Radio	6625-00-855-9447	V86784	B16	A	1623.00	P	MX-3736/ARM-45		Collins #476M-1
AN/ARM-63	Test Set, Radio	6625-00-868-8323	V87205	B16	A	3098.00	P	TS-1797/ARM-63	RS AN/ARM-42	Acft Radio Corp #BTK-35A
AN/ARM-68	Test Set, Radio	6625-00-889-1572	V87342	B16	A	638.00	P	TS-1458/ARM-68		Admiral #GB3555
AN/ARM-69	Frequency Converter Electronics	6625-00-082-4281	F01197	B16	A	850.00	P	CN-895/ARM-69	RS AN/GRM-4	Acft Radio Corp #BTK-34A

SDT. Figure 1-16 displays the additional equipment characteristics which may be estimated and indicates which of these characteristics are used in task identification. Identification of task elements can be facilitated by the types of controls and displays which are associated with the equipment. Displays and controls provide the focal point of the man-machine interface. Another important set of equipment characteristics for task identification are descriptions of the information inputs and outputs which are associated with each major equipment item. This input/output information is critical for those equipments which perform some analytical/software function. These equipment information inputs/outputs play a key role in determining human task inputs/outputs.

In addition, available data on equipment reliability and costs can be entered on this worksheet.

1.4.2 Determine BCS Operational and Support Concepts

After construction of the BCS equipment list, information on the operational and support concepts of the BCS should be obtained. (Definitions of the terms operational and support concepts are provided in Procedure 1.2).

Operational concepts are documented in the TRADOC Pam 525 series. As described in TRADOC Reg. 11-7, the operational concept describes "the performance of one or more combat, combat support, or combat service support functions. Each operational concept defines <u>what</u> needs to be done; <u>why</u> it needs to be done; <u>how</u> it is to be done; <u>where</u> it needs to be done; and <u>who</u> does it" (TRADOC Reg 11-7, pg. 3).

Figure 1-16 BCS Equipment Description Worksheet (EQP)*

Worksheet # ________

Procedure I.4																		
Manufacturers P/N	Reliability Data			Number Supported				Display/ Control	D/C Type	Costs					Information Inputs		Information Output	
	MTBF	MTTR	MTBMA	Crew	ORG	DS	DEPOT			—	—	—	—	—	Input	Source (Equip#)	Input	Source (Equip#)
(d)	(e)	(e)	(e)	(f)	(f)	(f)	(f)	(g)	(h)	(i)	(i)	(i)	(i)	(i)	(j)	(j)	(k)	(k)

*All items are optional

An overview of the information contained in the operational concept is presented in Table 1-11.

Support concepts for BCS subsystems should be available in (a) the program documentation for that subsystem, particularly logistics support analysis documentation and (b) maintenance and operator manuals for the equipment.

BCS operational and support concepts should be documented in the OSC worksheet listed in Figure 1-7.

1.4.3 Describe Function Sequence and Information Flow

BCS function sequence information can be obtained from How-to-Fight manuals and ARTEPs associated with the BCS equipment. Function sequence information should be entered into the worksheet listed in Figure 1-17.

Information flow data describing the inputs and outputs associated with each BCS equipment may also be identified (this information is particularly valuable in identifying task requirements for automated systems). Information flow data should be available in the operator and/or maintenance manuals associated with the BCS equipments. Once identified, the BCS information flow data should be entered into columns (j) and (k) of the EQP worksheet listed in Figure 1-16.

1.4.4 Document Data

Relevant data collected in this procedure must be entered into the SDT. This data should be entered as the worksheets contained in Figures 1-15, 1-16, and 1-17 are completed. Table 1-12 describes the sequence with which these data

TABLE 1-11. FORMAT OF THE OPERATIONAL CONCEPT AND CONCEPT STATEMENT*

Edition (i.e., 1st Draft
2nd Draft, etc.)

Date____________________

1. Purpose:

- WHY is the concept needed?

- WHAT needs to be accomplished?

- Are there influences of geography, climate, threat, or technology? If there are, state them in general terms. If necessary, give a detailed explanation in an annex.

- If the concept is one of a set, common environmental parameters may be stated in a preface to the set. Individual concepts or concept statements need only reflect that they are a part of the set.

2. Limitations:

- State any limiting assumptions of facts.

  • For example, a concept may not apply to joint or combined operations, or,

  • A concept may be applicable only to the Mideast or Central Europe.

3. The operational concept:

- HOW is the task to be done?

  • How the operation will be performed and how it relates to other operations performed simultaneously or in support.

- WHERE is it to be done on the battlefield?

  • Covering force area, the main battle area, etc.

- WHEN is it to be done in relation to other battlefield activities?

- WHO does it?

  • What echelon of command performs this task?

4. ANNEXES (As appropriate)

- Glossary of terms/acronyms

- Bibliography

*Taken from TRADOC Reg 11-7.

Figure 1-17. Function Sequence Worksheet (FSQ)

System ________ Worksheet # ________ # ________ of ________

Procedure 1.3							
Function # (a)	Function Name (b)	Preceding Functions		Succeeding Functions		Concurrent Functions	
		# (c)	Name (d)	# (e)	Name (f)	# (g)	Name (h)

TABLE 1-12. GUIDELINES FOR ENTERING DATA INTO SDT

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.4	BCS Equipment Name	Equipment	EQP	(b)	1
1.4	BCS Equipment Number	Equipment	EQP	(a)	1
1.4	FGC/WBC/WUC	Equipment	EQP	(c)	2
1.4	MFG's Part Number	Equipment	EQP	(d)	2
1.4	Reliability Data (MTBF, MTTR, MTBMA)	Equipment	EQP	(e)	3 (opt.)
1.4	Number Supported (crew, org. DS, depot)	Equipment	EQP	(f)	3 (opt.)
1.4	Display/Control Type	Equipment	EQP	(g), (h)	4 (opt.)
1.4	Costs	Equipment	EQP	(i)	5 (opt.)
1.4	Information Inputs	Equipment	EQP	(j)	6 (opt.)
1.4	Information Outputs	Equipment	EQP	(k)	6 (opt.)
1.4	Software Requirements	Equipment	EQP	(l)	7 (opt.)
1.5	Preceding Functions	Function	FSQ	(c)	8 (opt.)

TABLE 1-12. GUIDELINES FOR ENTERING DATA INTO SDT (Cont.)

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.5	Succeeding Functions	Function	FSQ	(e)	8 (opt.)
1.5	Concurrent Functions	Function	FSQ	(g)	8 (opt.)
					opt = optional

should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide.

1.5 IDENTIFY REQUIRED SYSTEM IMPROVEMENTS/NEW TECHNOLOGIES

OVERVIEW

The purpose of this procedure is to identify system improvements/new technologies required for the New system. The New system is defined as the best estimate of New system design, incorporating modified or improved design features, technological advances, new operating and support concepts, and changes to other system elements. As with the BCS, the New system must fulfill all functional requirements. Unlike the BCS, however, the New system is expected to meet all system performance criteria. The objective of this procedure is to identify and describe functional areas where the BCS system fails to meet required performance goals or standards.

PROCEDURE

An overview of the steps comprising this procedure is presented in Figure 1-18.

1.5.1 Identify Required System Improvements

This procedure begins with the comparison of the functional requirements for the New system and its associated performance requirements, to the capabilities of each of the BCS subsystems. This comparison was initiated during Procedure 1.4 (See Figure 1-14). In this procedure, a more

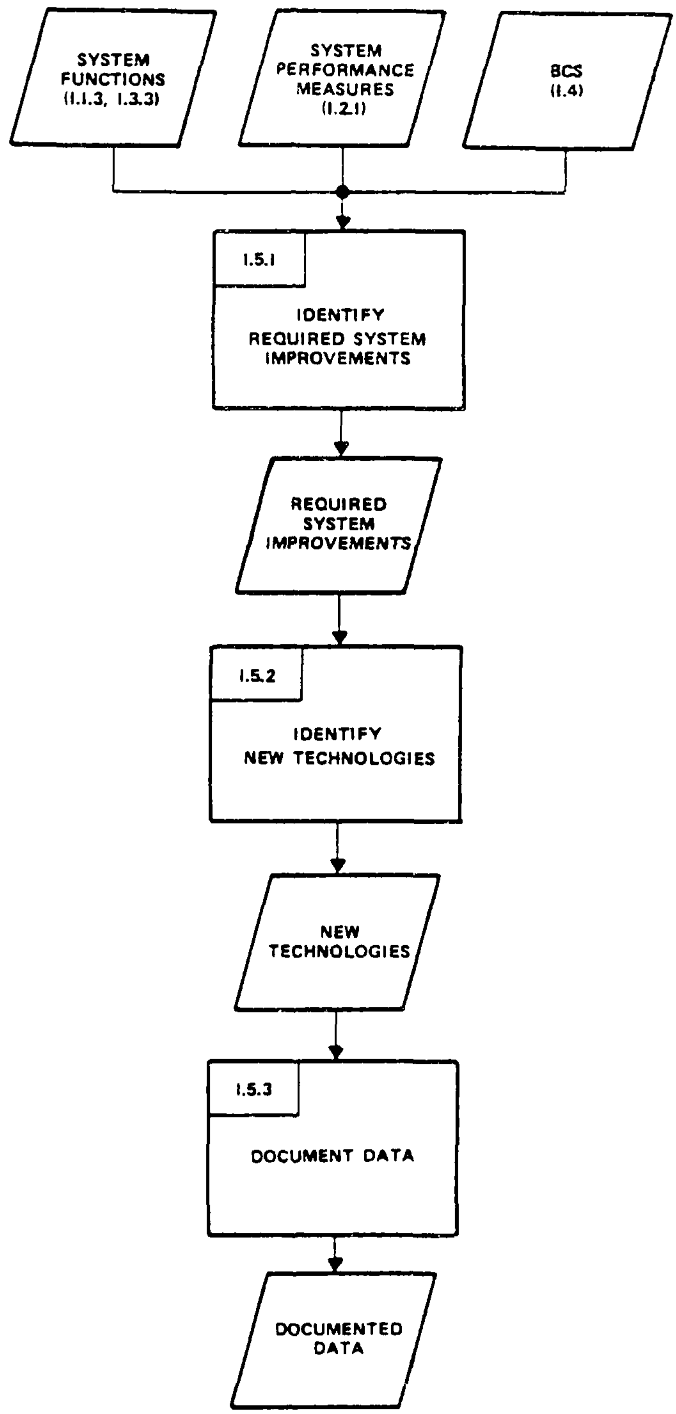

FIGURE 1-18. Overview Diagram: Identify Required System Improvements/New Technologies (1.5).

detailed comparison is conducted to identify areas where the BCS does not meet the performance standards required by the New system. If a new system description and/or equipment list is available from the contractor, it would be utilized to identify performance improvements (over the BCS) which are part of the contractor's design. Some of these improvements may exceed stated system performance goals. These additional performance improvements would also be documented. The results of this analysis are documented on a Baseline Comparison Performance Shortfall Worksheet (PSH), as shown in Figure 1-19.

First, the BCS equipments are entered into columns (a), (b), and (c). Second, the New system performance requirements are entered in column (d). Third, performance gaps; that is, areas where the BCS does not meet the performance requirements of the New system, are identified and entered into column (e).

The same subject matter experts who assisted in the identification of BCS subsystems should be used to identify the BCS performance shortfalls.

1.5.2 Identify New Technologies

The purpose of this procedure is to identify new technologies which can satisfy each of the required performance improvements identified by the previous procedure. The estimate of the New system design is made by incorporating desired and feasible technological improvements. If a New system equipment description is available from the contractor, the identification of new technologies which could meet each of the required design improvements is

Figure 1-19 Baseline Comparison Performance Shortfall Worksheet (PSH)

System DSWS

W..ksheet # ______

*SDT Input/Output

		1.6	Procedure 1.5		1.7
Baseline Comparison System			New System		
BCS Equipment		Function Name*	System Performance Goals*	Performance Shortfalls / Required Improvements	New Technologies
Number*	Name*				
(a)	(b)	(c)	(d)	(e)	(f)
1912.0	MK45 MOD Ø LWGM Autoloader		Fire rate up to 12 rpm manual rate ≥ 4 rpm	too big to fit in intended howitzer/ reduce in size maintain/upgrade automated gun-loading maintain manual backup capability	
.1	Loader drum position sensors	store 20 rounds in loader	55 round capacity automatic inventory control/monitoring	expand magazine load capacity improve projectile/propellant inventory control/monitoring	micro-processing to control magazine operation optical scanning of ammunition identification for inventory ammunition inventory software
		index loader drum	fire rate up to 12 rpm	tie inventory control/monitoring to loader drum indexing improve indexing speed	
.4	Ejectors	extract complete round with ejectors			
.5	Upper Hoist Upper Hoist Drive Hoist & Chain Pawl Hoist Tube Position Sensors Proj. Unlocking Door Prop. Unlocking Door	transfer complete round with upper hoist		reduce in size	

Figure 1-19 Baseline Comparison Performance Shortfall Worksheet (PSH) (Continued)

System DSWS

Worksheet # ______

*SDT Input/Output

Procedure 1.5					
Baseline Comparison System			New System		
BCS Equipment Number*	BCS Equipment Name*	Function Name*	System Performance Goals*	Performance Shortfalls / Required Improvements	New Technologies
(a)	(b)	(c)	(d)	(e)	(f)
1912.3	Cradle Position Sensors	position complete round for ramming			
3401.3	Verticle Sliding Breech Position Sensors	open breech close breech			
.4	Percussion firing mechanism	fire gun			electronic firing for improved reliability/maintainability (R.M) and safety
3403.1	Mechanical Fuze Setter	set fuze			
		Maintain the MK45 MOD Ø LWGM autoloader: Service Test Adjust Fault/Isolate Remove & Replace Repair			

Figure 1-19 Baseline Comparison Performance Shortfall Worksheet (PSH) (Continued)

System DSWS

Worksheet # ____

*SDT Input/Output

Procedure 1.5					
Baseline Comparison System			New System		
BCS Equipment		Function Name*	System Performance Goals*	Performance Shortfalls / Required Improvements	New Technologies
Number*	Name*				
(a)	(b)	(c)	(d)	(e)	(f)
		perform autoloader pre-fire checks			
		perform autoloader post-fire checks/ maintenance			
		Record/Report ammunition expen- ditures	35 - 40 tgts/hour rapid and frequent ammunition resupply	reduce ammo inventory administration	

relatively straightforward. The required technology information could be obtained directly from the New system equipment description. If a New system equipment description is not available from the contractor, other sources would be used to identify the new technologies. There are two major sources of such information: (1) equipment related literature and documents, and (2) interviews with subject matter experts. The primary source for the identification of new technologies, and the source which will probably prove to be the easiest to access, are interviews with subject matter experts who have expertise in each of the new technology areas associated with the BCS equipments.

More specifically, the Baseline Comparison Performance Shortfall Worksheet with columns (a) thru (e) filled in should be presented to hardware subject matter experts from the functional areas associated with each major BCS subsystem. These analysts should then be asked to indicate what new technologies can be added to the BCS equipment to eliminate the performance gaps. Once identified, the new technologies should be entered into column (f).

1.5.3 Document Data

Information on new technologies should be documented in the worksheet listed in Figure 1-19.

1.6 FORMAT NEW SYSTEM

OVERVIEW

During this step, the new technologies to be incorporated in the New system design(s) must be examined and differences

between the BCS and the New system which impact human task performance must be identified. These design differences will be analyzed in detail in subsequent procedures and used to modify BCS data to reflect the infusion of new technologies identified in Procedure 1.5.

PROCEDURE

An overview of the steps comprising this procedure is presented in Figure 1-20.

1.6.1 Describe Design Differences

A design difference (DD) worksheet has been developed to assist the analyst in describing the equipment associated with each design difference (see Figure 1-21).

The information in columns (a) and (b), describing the BCS equipments, can be taken directly from columns (a) and (b) of the BCS EQP worksheet. After these two columns are filled in, column and listing the New system equipment associated with each BCS equipment should be filled in. These New system equipments are developed by combining the new technologies listed in column (f) of the PSH worksheet with the BCS equipments. Once the New system equipments have been identified, subject matter experts who are familiar with the BCS equipments should be presented with the partially completed DD worksheet and the completed PSH worksheet and asked to identify and describe any potential hardware/software differences between the BCS and New system equipments which might impact the task performance of operators, maintainers, or support personnel. If possible, they should be asked to assign a quantitative value to these

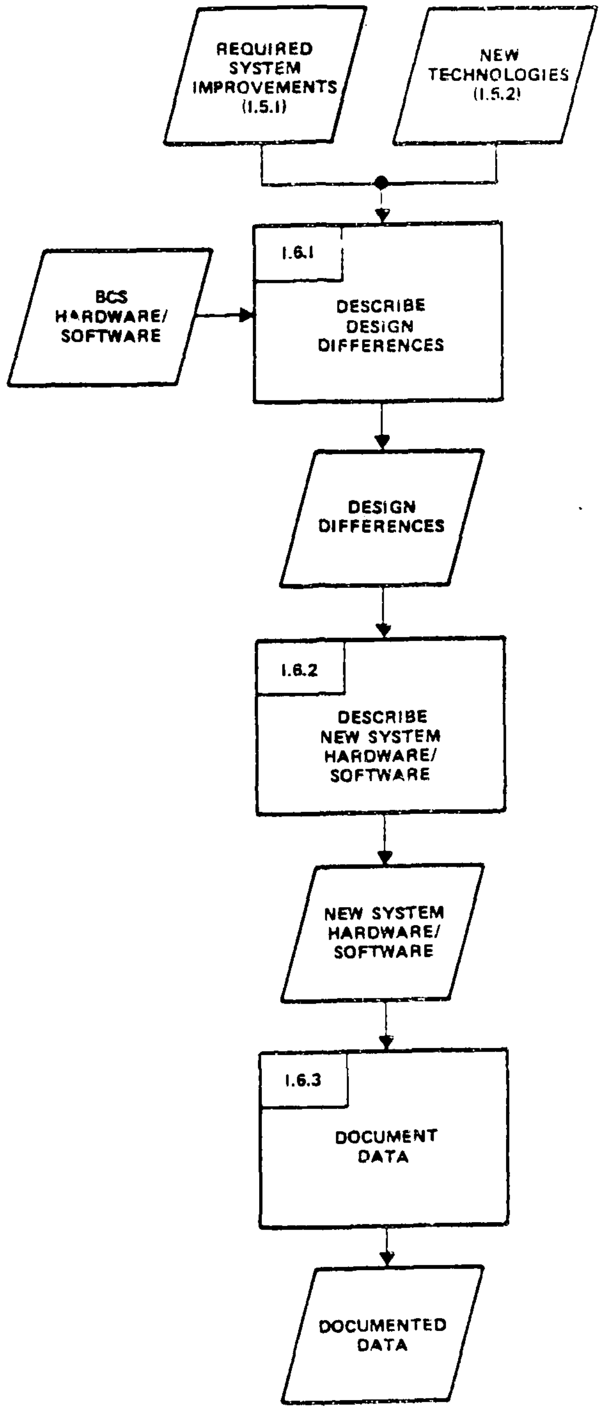

FIGURE 1-20. Overview Diagram: Format New System (1.6)

design differences. The subject matter experts should b asked to focus on hardware/software featu es (for exampl reliability, maintainability).

1.6.2 Describe New System Hardware/Software

During this procedure, a hierarchical equipment structur for the New system is constructed. The Design Differenc worksheet described in Figure 1-21 will contain a listing o New system equipments. These equipments must be examine and placed in a hierarchical equipment structure. If a Ne equipment design is available from the contractor thi equipment structure can be taken directly from contracto supplied data.

After the New system equipment structure is identified, th New system equipments may be described in more detail (se Figure 1-22) in a New system Equipment Description Work- sheet. Many of the data elements on the worksheet may no be available until later in the acquisition process (see th data source index in Appendix E for a listing of potentia data sources).

1.6.3 Document Data

Relevant data collected in this procedure must be entere into the SDT. This data shall be entered as the workshee contained in Figure 1-22 is completed. Table 1-13 describe the sequence with which these data should be entered int the SDT. Additional guidelines for entering data into th SDT are contained in the SDT User's Guide.

Figure 1-21 Design Difference Worksheet (DD)
Worksheet # ______

BCS Equip Number	BCS Equipment Name	Design Difference	New System Equipment			Comments
			Number	Name	Contractor Cross Reference No.	
(a)	(b)	(c)	(d)			(e)

Figure 1-22. New System Equipment Description Worksheet (EQP)*

System ________ Worksheet # ________ ______ of ______

Procedure 1.4																							
Equip. #	Equipment Name	FGC WBC WUC	Manufac-turers P/N	Reliability Data			Number Supported				Display/ Control	D/C Type	Costs					Information Inputs		Information Outputs		Software Requirements	Other
				MTBF	MTTR	MTBMA	Crew	ORG	DS	DEPOT			—	—	—	—	—	Input	Source (Equip#)	Input	Source (Equip#)		
(a)	(b)	(c)	(d)	(e)	(e)	(e)	(f)	(f)	(f)	(f)	(g)	(h)	(i)	(i)	(i)	(i)	(i)	(j)	(k)	(k)	(k)	(l)	(m)

*Note: Items (e) through (i) are optional

Table 1-13. Guidelines for Entering Data Into SDT.

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
1.6	New Equipment Name	Equipment	EQP	(b)	1
1.6	New Equipment Number	Equipment	EQP	(a)	1
1.6	FGC/WBC/WUC	Equipment	EQP	(c)	2 (opt.)
1.6	MFG's Part Number	Equipment	EQP	(d)	2 (opt.)
1.6	Reliability Data (MTBF, MTTR, MTBMA)	Equipment	EQP	(e)	3 (opt.)
1.6	Number Supported (crew, org. DS, depot)	Equipment	EQP	(f)	3 (opt.)
1.6	Display/Control Type	Equipment	EQP	(g), (h)	4 (opt.)
1.6	Costs	Equipment	EQP	(i)	5 (opt.)
1.6	Information Inputs	Equipment	EQP	(j)	6 (opt.)
1.6	Information Outputs	Equipment	EQP	(k)	6 (opt.)
1.6	Software Requirements	Equipment	EQP	(l)	7 (opt.)
1.6	Comparable Equipment	Equipment	-	-	1 (opt.)

opt. = optional

SECTION 2.0 - GENERATE TASKS

OVERVIEW

During this procedure, task lists are generated for the Baseline Comparison System (BCS) and the New System. In addition, the tasks in each of these systems are assigned to duty position, skill level, and MOS.

PROCEDURE

This procedure consists of five lower level procedures (see Figure 2-1). During the first procedure, relevant task data from the Predecessor system and other comparable existing systems is collected. In the second procedure, the BCS tasks are generated. In the third procedure, the BCS tasks are assigned to duty position, skill level, and MOS. In the fourth procedure, a New system task list is generated. Finally, in the fifth procedure, the New system tasks are assigned to duty position, skill level, and MOS.

2.1 IDENTIFY, COLLECT AND FORMAT TASK DATA

OVERVIEW

During this procedure, task data are collected for all Military Occupational Specialties (MOSs) which may be relevant to the BCS or New system.

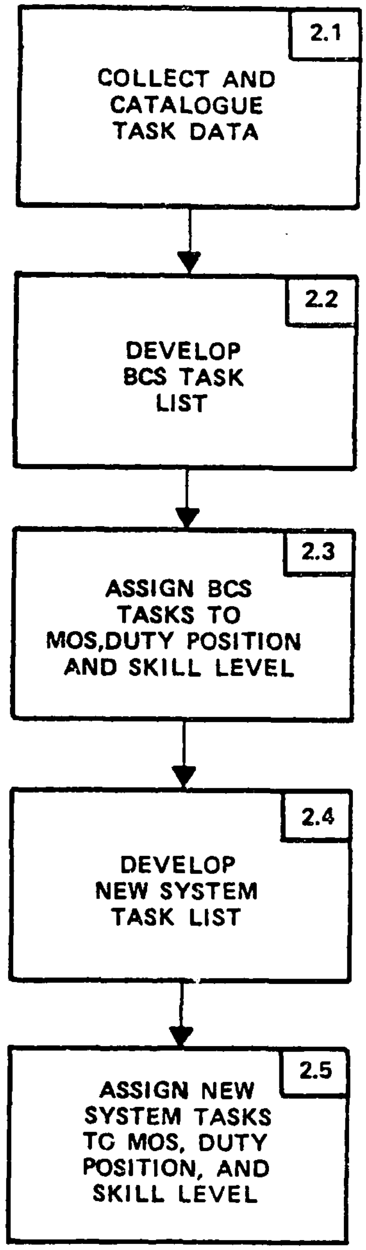

Figure 2-1. Overview Diagram: Generate Tasks (2.0)

PROCEDURE

An overview of the steps in this procedure is presented in the flowchart in Figure 2-2. A worksheet which can be used to support this procedure is provided in Figure 2-3 (CND). There are two steps in the procedure. In the first step, candidate occupational specialities are identified. In the second step, task data on these occupational specialties are collected and formatted.

2.1.1 Identify MOSs Currently Performing Similar Functions

The purpose of this step is to identify all existing occupational specialties which may be relevant to the New system.

To begin the step, information on the new equipment number and name should be entered into columns (a) and (b) of the CND worksheet. This information can be obtained from columns (e) and (f) of the BCS worksheet (see Section 1.4.1).

Second, if the BCS equipment is in the current Army inventory, this information should be noted in column (c).

Third, the occupational specialties which currently operate and maintain the BCS equipment should be entered into column (d). Information on operator MOSs should be readily available from the schools associated with BCS equipment. Information on maintenance MOSs can be obtained from the maintenance manuals associated with the BCS equipment. Information on Navy and Air Force occupational specialties can be obtained from the Navy Enlisted Manpower and

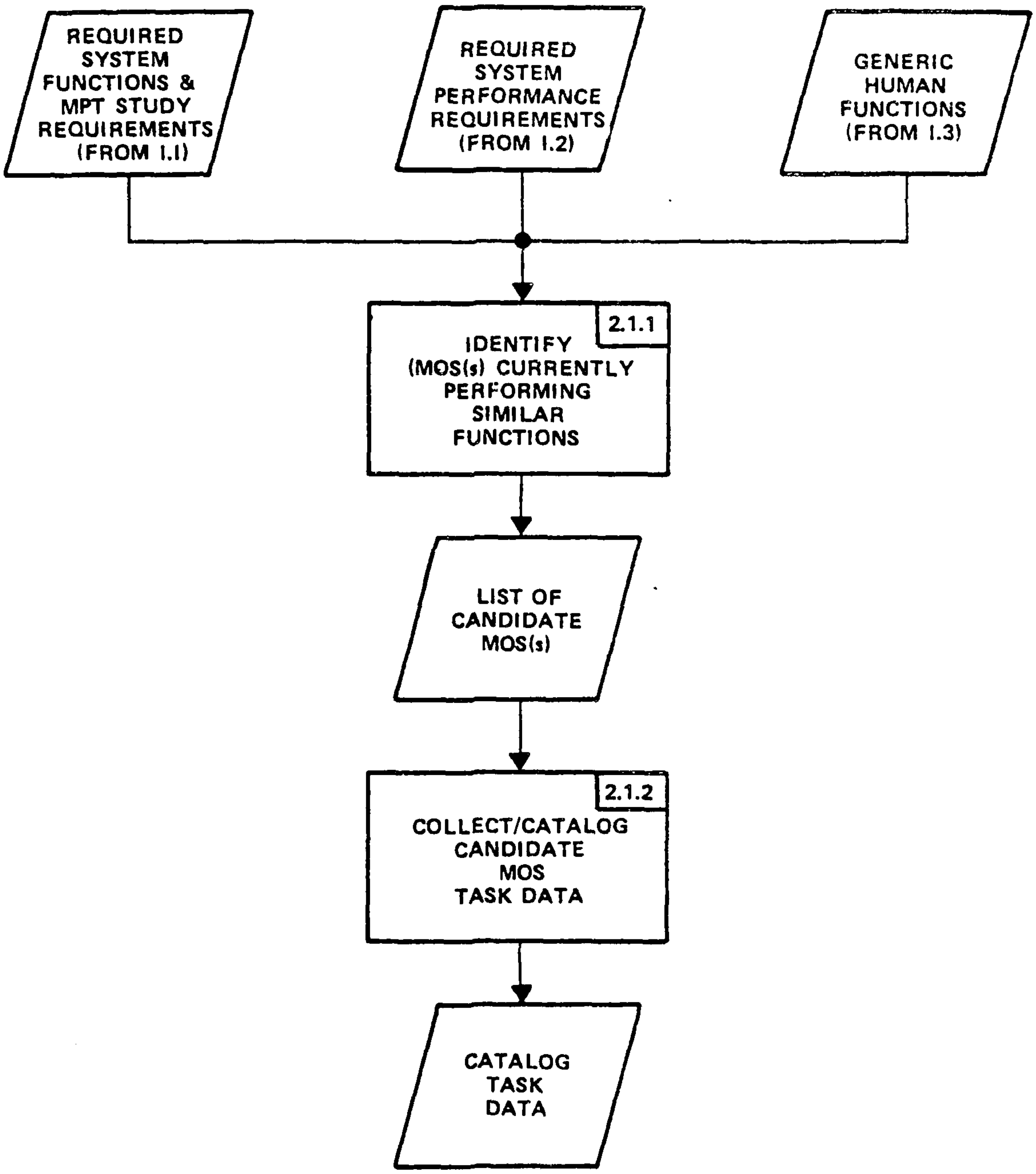

Figure 2-2. Identify, Collect, and Format Task Data.

BCS	EQUIPMENT	(C) INVENTORY		(D) OCCUPATIONAL SPECIALTIES	(E) TASK DATA COLLECTED/CATALOGUED			
EQUIP. NUMBER(a)	EQUIPMENT NAME (B)	ARMY	NON-ARMY		SOLDIER'S MANUAL	TRAINER'S GUIDE	CODAP	OTHER

Figure 2-3. Candidate MOS Worksheet (CND).

Personnel Classifications and Occupational Standards and Air Force Regulation 39-1 (see Appendix E for a more complete listing of data sources).

2.1.2 Collect and Catalog Candidate MOS Task Data

During this step, all available task data on the candidate MOSs identified in step 2.1.1 must be collected. A listing of potential sources of task data is provided in Table 2-1 (a more complete list is provided in Appendix E). The best sources of task data for existing Army systems are Soldier's Manuals and the Trainer's Guides.

As task data is collected, it should be documented in column (e) of the CND worksheet listed in Figure 2-3 and in the library index.

2.2 DEVELOP BASELINE COMPARISON SYSTEM (BCS) TASK LIST

OVERVIEW

During this procedure, a task list is generated for the Baseline Comparison System. The BCS is composed of the existing subsystems (including the predecessor subsystems) which come closest to meeting the New system functional requirements (see Section 1.4 for a more detailed description).

PROCEDURE

An overview of the steps in this procedure is presented in Figure 2-4. A worksheet which can be used to support this procedure is provided in Figure 2-5 (BCST).

Table 2-1. Task Data So rces.

- Soldier Manuals**
- Trainer's Guide**
- Job Book**
- CODAP**
- LSAR*
- ARTEPs**
- Field Manuals**
- Maintenance Manuals**
- Skill Performance Aids**
- Maintenance Allocation Charts*
- Training Development Information System (TDIS)**
- Contractor Supplied Training Programs*
- Program of Instruction (POI)

*Data source for developing system
**Data source for existing system

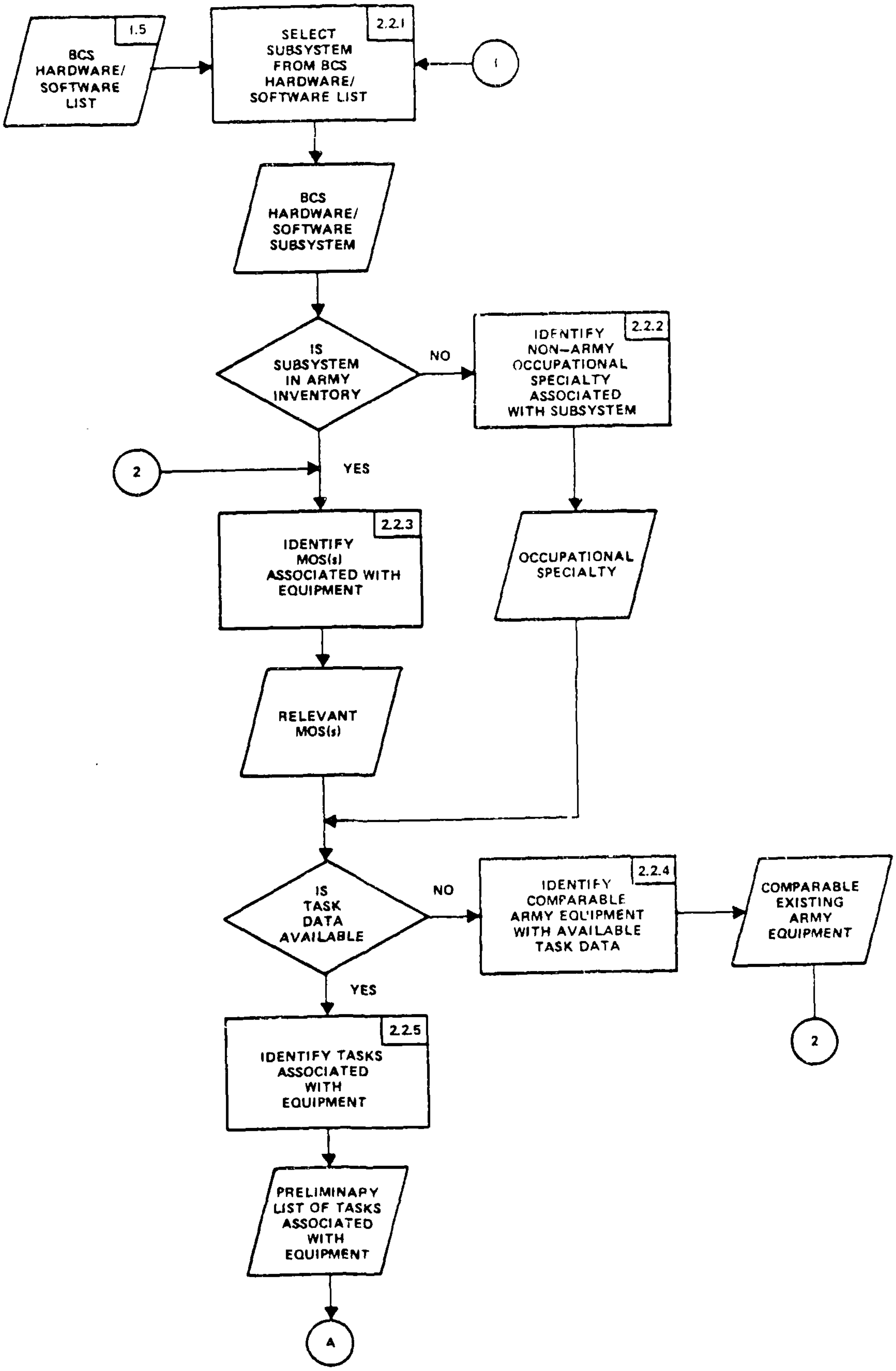

Figure 2-4. Develop BCS Task List (2.2).

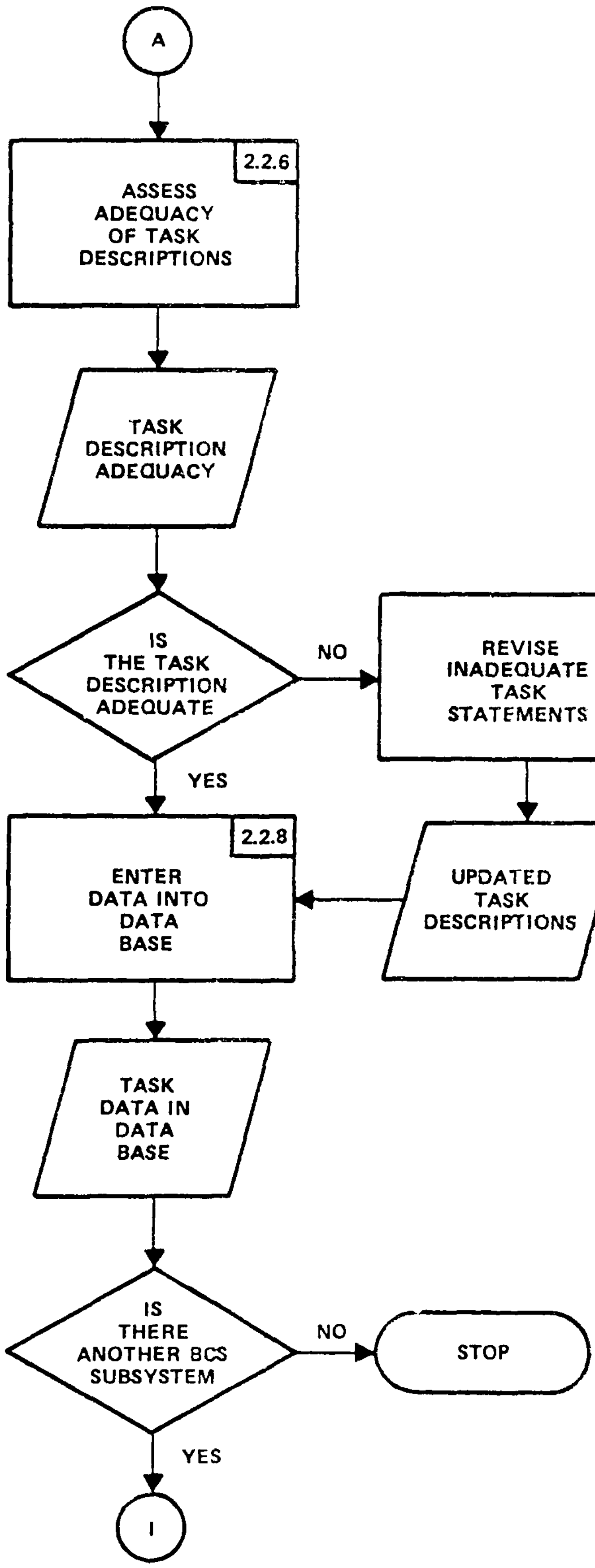

Figure 2-4 (continued)

SYSTEM ____________ PAGE ____ OF ____

A BCS EQUIPMENT NUMBER NAME	B ASSOC ARMY MOS	C NON ARMY OCCUPATIONAL SPECIALTY	D COMPARABLE ARMY EQUIPMENT	E COMPARABLE ARMY TASK	F ASSOC ARMY MOS	G COMP DUTY POSITION	H ASSOC SKILL LEVEL	I ARMY TASK DATA SOURCE	J BCS TASK NUMBER	K BCS TASK STATEMENTS	L BCS DUTY POSITION	M BCS SKILL LEVEL	N BCS MOS	O TASK CONDITION	P TASK STANDARD

Figure 2-5. BCS Task Association Worksheet (BCST).

2.2.1 Select Subsystem From BCS Hardware/Software List

To begin the procedure, the BCS equipment number and name should be entered into columns (a) and (b) of the BCST worksheet (This information can be obtained from columns (e) and (f) of the BCS worksheet in Section 1.4.1).

Once this information is entered, you must determine if the BCS equipment is currently in the Army inventory. (This information is available in column (g) of the CND worksheet used in Procedure 2.1). If the BCS equipment is in the Army inventory, you should proceed to step 2.2.3. If the BCS equipment is not in the Army inventory, you should proceed to step 2.2.2.

2.2.2 Identify Non-Army Occupational Specialty

Information on non-Army occupational specialties can be obtained from the Navy Enlisted Manpower and Personnel Classifications and Occupational Standards and from Air Force Regulation 39-1. A more complete list of data sources is provided in Appendix E. Once the occupational specialty is identified, it should be listed in column (c) of the BCST worksheet.

2.2.3 Identify MOSs Associated With Equipment

The best data source for linking MOS to equipment is the Table of Equipments Manpower Authorization Criteria (MACRIT) found in army Regulation AR 570-2. However, new equipments are not likely to be listed in MACRIT. For new systems, you must identify the proponent for the equipment/subsystem or the system to which the equipment/subsystem belongs. Once

the system proponent has been identified, you must call the proponent school (see Table 1-3 in Section 1.0) to obtain MOS information. The most definitive data source for identifying MOSs for Army equipments is Army Regulation 611-201, Enlisted Career Management Field and Military Occupational Specialties. This document describes the general types of activities performed by each Army MOS.

2.2.4 Identify Comparable Army Equipment

Comparable Army equipment must be identified for each BCS equipment that is not in the Army inventory. Procedures for identifying comparable equipment are listed in Section 1.4. Once identified, the comparable equipment should be listed in column (d) of the BCST worksheet and occupational specialties for these equipments should be identified using information listed in Step 2.2.3.

2.2.5 Identify Tasks Associated With Equipment

The tasks associated with each BCS equipment, which is in the Army inventory, should be obtained from the Army task data sources listed in Appendix E (This task data should have been collected during procedure 2.1). Most of the time, these tasks should be used in the BCS task list without modification. However, before including these tasks in the BCS, they should be examined, and when necessary, updated to reflect any equipment or doctrinal changes that were made since the task data was published. A list of sources for monitoring these changes is presented in Table 2-2.

Table 2-2. List of Data Sources for Monitoring Equipment/Doctrinal Changes for Existing Systems*

- Tables of Organization and Equipment (TOE)
- Tables of Distribution and Allowances (TDA)
- Job Supervisor Interview
- Subject Matter Experts (SME)
- Equipment Modification Work Orders
- Directorate of Combat Development (Organization and Operations Concept)
- DA/TRADOC Circulars and Pamphlets
- Army Regulations
- Technical Manuals
- Soldier's Manuals

*Derived from Schulz and Farrel (1980)

Similarly, if the BCS equipment is not in the Army inventory, task information should be obtained from the appropriate non-Army data source (see Appendix E for a listing of these data sources). Input for this process is provided by non-Army occupational specialties listed in column (c) of the BCST worksheet. As with the Army tasks, the non-Army tasks should be updated to reflect any equipments or doctrinal changes that were made since the task data was published.

2.2.6 Assess Adequacy of Task Descriptions

Before entering the task statements obtained from existing data sources into the BCST worksheet and the SDT, the user must assess the instructional adequacy of these task statements. Instructional adequacy refers to the extent to which the task data has been developed in accordance with existing Instructional System Development (ISD) processes. Table 2-3 displays criteria for assessing instructional adequacy as well as some data sources for obtaining more detailed guidance on assessing the adequacy of task descriptions. As indicated in the introduction to this guide, it is expected that ETES users are thoroughly familiar with ISD and therefore know what constitutes a "good" task statement. Hence, detailed instructions on constructing task statements are not provided in this guide.

If the instructional adequacy of a task statement is good, you can enter the task statement into column (k) of the BCST worksheet.

If a task statement is not adequate, you must generate a new statement for that task (See Step 2.2.7 below).

TABLE 2-3 CRITERIA AND SOURCES FOR ASSESSING INSTRUCTIONAL ADEQUACY OF TASK DATA

CONDITION(S) (INPUT)	PERFORMANCE/ BEHAVIOR(S) (ACTION)	STANDARD(S) (OUTPUT)
DESCRIPTION OF THE CONDITION(S) OF PERFORMANCE—WHAT IS PRESENTED TO THE STUDENT	DESCRIPTION OF THE ACTION OR BEHAVIOR—WHAT THE STUDENT IS EXPECTED TO DO	A STATEMENT OF THE OUTPUT OR OUTCOME OF THE PERFORMANCE AND THE STANDARD(S) OF PERFORMANCE
INPUT(S) INCLUDE: JOB AIDS EQUIPMENT TECHNICAL REFERENCES SPECIAL TOOLS ENVIRONMENT CONDITIONS SPECIAL INSTRUCTIONS SIGNALS, SYMBOLS PROBLEM SITUATIONS OR CONTINGENCIES	ACTION VERBS ARE: OBSERVABLE MEASURABLE VERIFIABLE RELIABLE (NOT PRONE TO VARYING INTERPRETATION)	RITERIA FOR STANDARDS: COMPLETENESS ACCURACY TYPES OF STANDARDS: STANDARD OPERATING PROCEDURE (SOP) NO ERROR TIME REQUIREMENTS AMOUNT OF SUPERVISION QUALITATIVE INDICES

Sources

TRADOC PAM 351-4, TRADOC Task Analysis Handbook
TRADOC PAM 350-30
Job and Task Analysis Course (Hale, Prelewicz, and Walton, 1979)
Job Aids: Descriptive Authoring flowcharts for Phase I - analyze of ISD (Schulz and Farrell, 1980).

2.2.7 Revise Task Descriptions

Inadequate task statements must be revised in accordance with existing ISD procedures. Guidelines for the development of task statements can be found in TRADOC PAM 350-30, Phase I, Section 1.2.3. Additional guidelines are provided in the data sources listed in Table 2-2. Once the task statements have been revised they should be entered into column (k) of the BCST worksheet.

After the task statements have been entered, task numbers should be assigned and entered into column (j) of the BCST worksheet. Table 2-4 provides some general guidelines for constructing task numbers. More detailed guidance is provided in TRADOC Cir 351-28 and AR 351-183.

2.2.8 Enter Data Into Data Base

Relevant data collected in this procedure must be entered into the SDT. Table 2-5 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide. Remember that separate SDT data bases should be maintained for the BCS and the New System.

2.3 ASSIGN BASELINE COMPARISON SYSTEM (BCS) TASKS TO MOS, DUTY POSITION, AND SKILL LEVEL

OVERVIEW

During this procedure, the BCS tasks are assigned to MOS, duty position, and skill level. Comparability analysis is used as the primary mechanism for making these assignments.

Table 2-4. Guidelines for Assigning Task Numbers

Enlisted Task Numbers (10 digits) - XXX-YYY-ZZZZ

XXX - Responsible Agency Code

YYY - System Subject Code

ZZZZ - Unique Sequence No. used by responsible agency to identify each task

Officer Task Numbers (12 digits) - V-W-XXXX-YY-ZZZZ

V - Current Disposition Indicator

W - Prefix (1-Commissioned, 2-Warrant, 3-Both)

XXXX - Basic Subject Area

YY - Additional Subject Area

ZZZZ - Unique Sequence No.

Table 2-5. Guidelines for Entering Data Into SDT (2.2).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
2.2	BCS Task Number	Task	BCST	J	2
2.2	BCS Task Title	Task	BCST	K	1

Comparability analysis provides rough-cut assignments that are only appropriate for the earliest phases of the acquisition process.[1]

PROCEDURE

An overview of the steps in this procedure is provided in Figure 2-6. During the first step, a duty position structure is identified for the BCS. In the second step, the BCS tasks are assigned to duty position and skill level. In the third step, duty positions are assigned to Army occupational specialties. In the fourth step, the MOS, duty position, and skill level assignments are reviewed to take into account any manpower or human factors analyses which may have been conducted during the early phases of the acquisition program. The BCST worksheet used in Procedure 2.2 to describe BCS tasks is also used in this procedure to describe MOS, duty position, and skill level assignments.

2.3.1 Identify Duty Position Structure

A duty position structure may be defined as a listing of the number and type of each duty position associated with a system. Construction of the BCS duty position structure occurs in two steps. First, the duty positions structure for the predecessor system are identified. Second, duty positions are added or deleted from the predecessor list to reflect the equipments that were added/deleted to the predecessor system to form the BCS system.

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[1] A description of comparability analysis procedures is provided in O'Brien (1983).

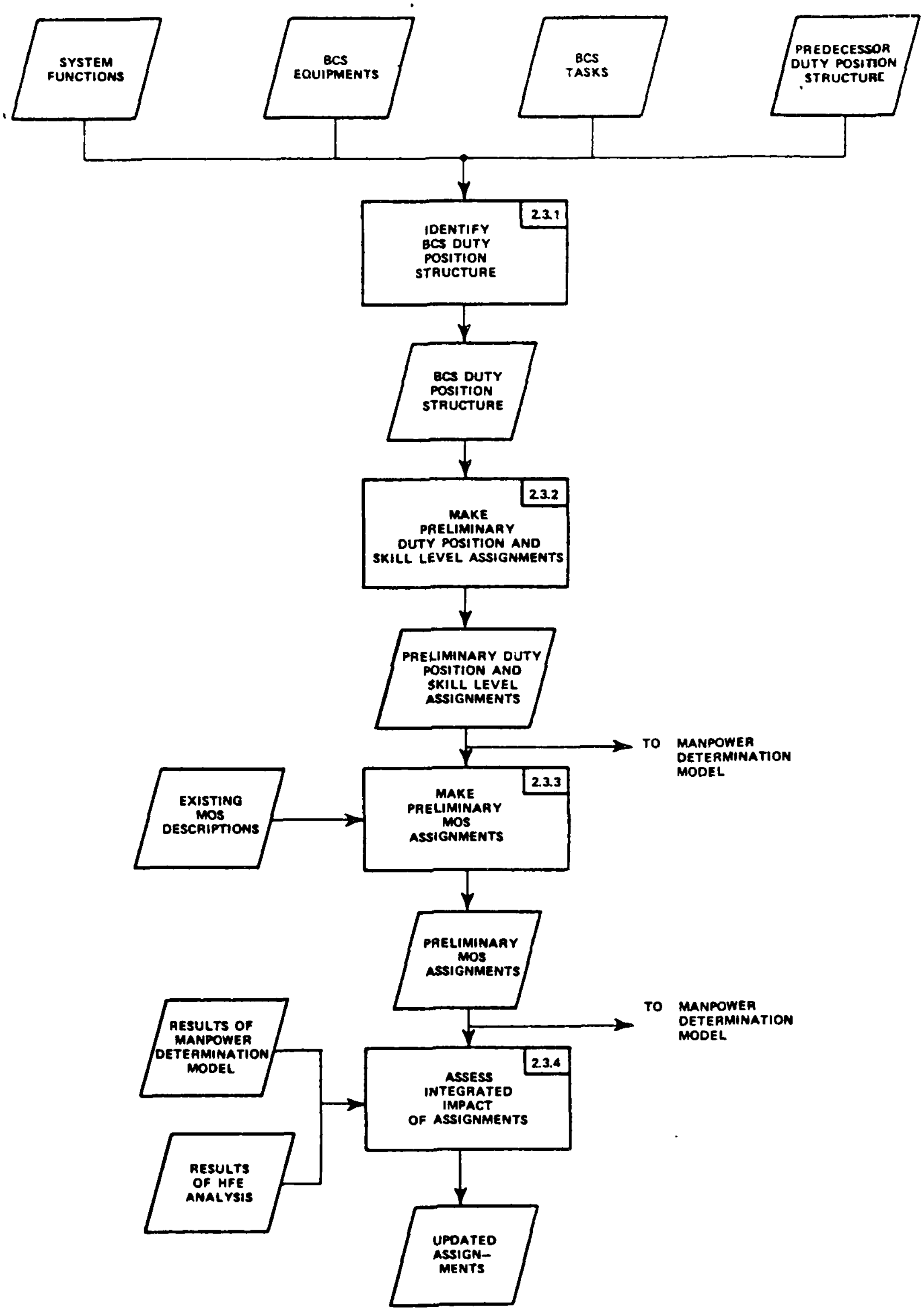

Figure 2-6. Overview Diagram: Assign BCS Tasks to MOS, Duty Position, and Skill Level (2.3).

2.3.2 Assign Tasks To Duty Position and Skill Level

Assignment of tasks to duty position and skill level is a three-step process. First, the BCS task list must be examined to identify any tasks which are associated with duty positions (or billets if a Navy system is involved) which are not in the BCS duty position structure identified in 2.3.1. The user must then identify what BCS duty positions would be most likely to perform the tasks associated with each of these other duty positions. This is accomplished by comparing the tasks already associated with the BCS duty positions and the tasks associated with the other duty positions.

Second, each task should be assigned to a BCS duty position. If a task is already associated with a BCS duty position, then that duty position should be assigned to the task. If a task is not currently assigned to a BCS duty position, it should be assigned to the BCS duty position which is most similar to the duty position from which it was derived.

Third, each BCS duty position should be assigned a skill level. This is accomplished by identifying similar duty positions in the predecessor or other similar systems and assigning the BCS duty position the skill level associated with that duty position.

2.3.3 Assign Tasks to MOS

Tasks are assigned to an MOS by comparing the tasks associated with the duty position to the task requirements of existing MOS that are relevant to the new system. Task requirements for MOSs can be identified by examining (a) AR

611-201 which describes the occupational specialties and (b) the Soldier's Manual for each specialty which provides detailed data on MOS tasks.

If none of the MOSs listed in AR 611-201 match the task requirements of the BCS, it may be necessary to establish requirements for a new MOS. Whenever possible, an existing MOS should be used since the cost of establishing a new MOS is significant. New MOSs should be designated by the terms X1, X2, X3, etc. in place of the two digits normally used to designate an MOS. More details on the requirements for establishing a new MOS are found in AR 611-1.

2.3.4 Assess Integrated Impacts of Assignments

Concurrent with an early training estimation study, there may be additional studies assessing the system manpower or human factors requirements.[2] If there are such studies, the MOS, duty position, and skill level assignments developed in the previous step should be updated to reflect the more detailed input that these manpower and human factors studies typically provide. (Such studies typically assess the workload of operators and maintainers and this workload data provides more detailed information on what tasks can be performed by each duty position.)

After the BCS skill level, duty position, and MOS assignments have been finalized, they should be entered into columns (e), (m), and (n) of the BCST worksheet, respectively.

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2 At the present time, such studies are seldom, if ever, conducted during the early phases of the acquisition process.

2.3.5 Document Data

Relevant data collected or developed in this procedure must be entered into the SDT. Table 2-6 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide. Remember that separate SDT data bases should be maintained for the BCS and New system.

2.4 DEVELOP NEW SYSTEM TASK LIST

OVERVIEW

During this procedure, a task list is generated for the New system. This is accomplished by adding, deleting, or modifying BCS tasks.

PROCEDURE

An overview of the steps in this procedure is presented in the flowchart in Figure 2-7. A worksheet (NTA) for documenting the procedure is provided in Figure 2-8.

To begin the procedure, the new technologies identified in column (f) of worksheet PSH as part of Procedure 1.5 should be entered in column (a) of the New System Task Generation Worksheet (NTA). The New system equipment list should then be entered into Columns (b) and (c) of the NTA worksheet. Information on New equipment names and numbers can be obtained from columns (a) and (b) of the Baseline Comparison System Performance Shortfall Worksheet (PSH).

Table 2-6. Guidelines for Entering Data Into SDT (2.3).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
2.3	BCS Duty Position	Duty Position	BCST	L	1
2.3	BCS Skill Level	Duty Position	BCST	M	1
2.3	BCS MOS	Duty Position	BCST	N	1
2.3	BCS Task-Duty Position Relationships	Duty Position	BCST	K,L	2
2.3	ASI	Duty Position	--	--	3(optional)
2.3	Position Type	Duty Position	--	--	3(optional)
2.3	Organizations	Duty Position	--	--	3(optional)

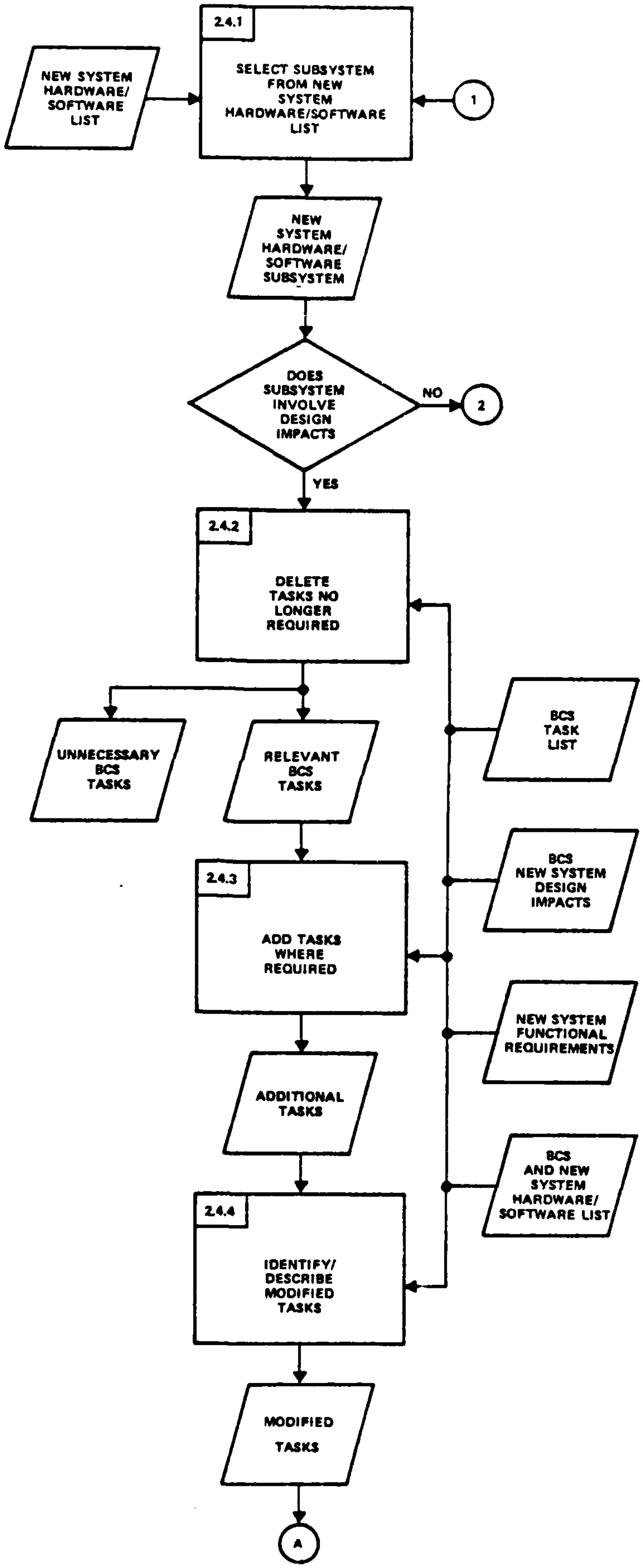

Figure 2-7. Overview Diagram: Develop New System Task List (2.4).

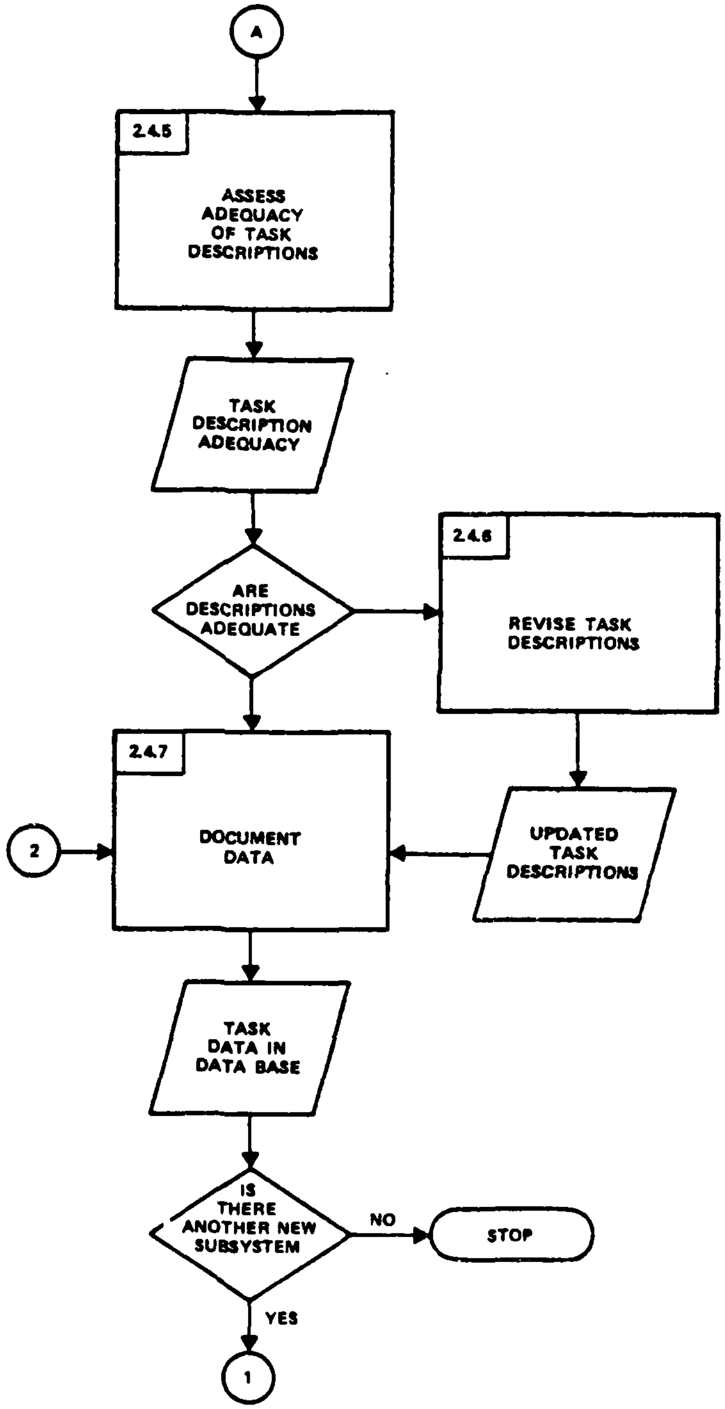

Figure 2-7 (continued)

Figure 2-8.

NTA Worksheet

It is only necessary to analyze tasks for those subsystems which are associated with design impacts. For all other subsystems, the baseline tasks can be used without modification.

A task list can be generated for the subsystems related to design impacts by adding or deleting tasks from the corresponding BCS subsystem. These additions or deletions should be documented using the codes listed in Table 2-7. More specifically, the BCS task data should be examined and compared to the New system hardware/software design and functional requirements. BCS tasks associated with equipments or functions which are no longer needed should be eliminated. New tasks should be added to reflect new equipment or functions. New functions can be identified by examining the functional requirements generated during Procedure 1.3. An overview of the relationship between subsystem functions and individual tasks is presented in Figure 2-9. As Figure 2-9 indicates, individual tasks can be viewed as lower level functions and these functions can provide a top-down perspective on task identification.

Identification of New system maintenance tasks can be facilitated by examining the standard list of action verbs that are used to describe maintenance tasks. A listing of these maintenance action verbs is presented in Table 2-8. As part of the system development, a Maintenance Allocation Chart (MAC) may be constructed for the New system. If a MAC is available, it can probably be obtained from the New system program office. The MAC is an excellent source of task data since it describes which of the standardized list of maintenance actions will be performed on the system and at what levels of maintenance these actions will be performed. Information on the MOSs performing each action is

TABLE 2-7 TASK DELETION/MODIFICATION/ADDITION CODES

TASK DELETION

Code	Reason for Deletion
ELI	Elimination of subsytem
AUT	Task Automation - task now performed by equipment
RTF	Reduced task frequency
MC	Change in maintenance concept/doctrine
OC	Change in operational concept/doctrine

TASK MODIFICATION

Code	Type of Modification
NC	No change in task
MIN	Minor task modification - task essentially the same. Only minor change in equipment/procedure required.
SKI	Skill level change - task essentially the same but assigned to different skill level.
FRE	Frequency change - Same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ	Major task modification - Significant change in skills and knowledges and/or other task characteristics.

TASK ADDITION

Code	Reason for Addition
ADD	Addition of subsystem
MAN	Automated task converted to manual
ITF	Increased task frequency
AMC	Change in maintenance concept/doctrine
AOC	Change in operational concept/doctrine
IT	Increase in technology

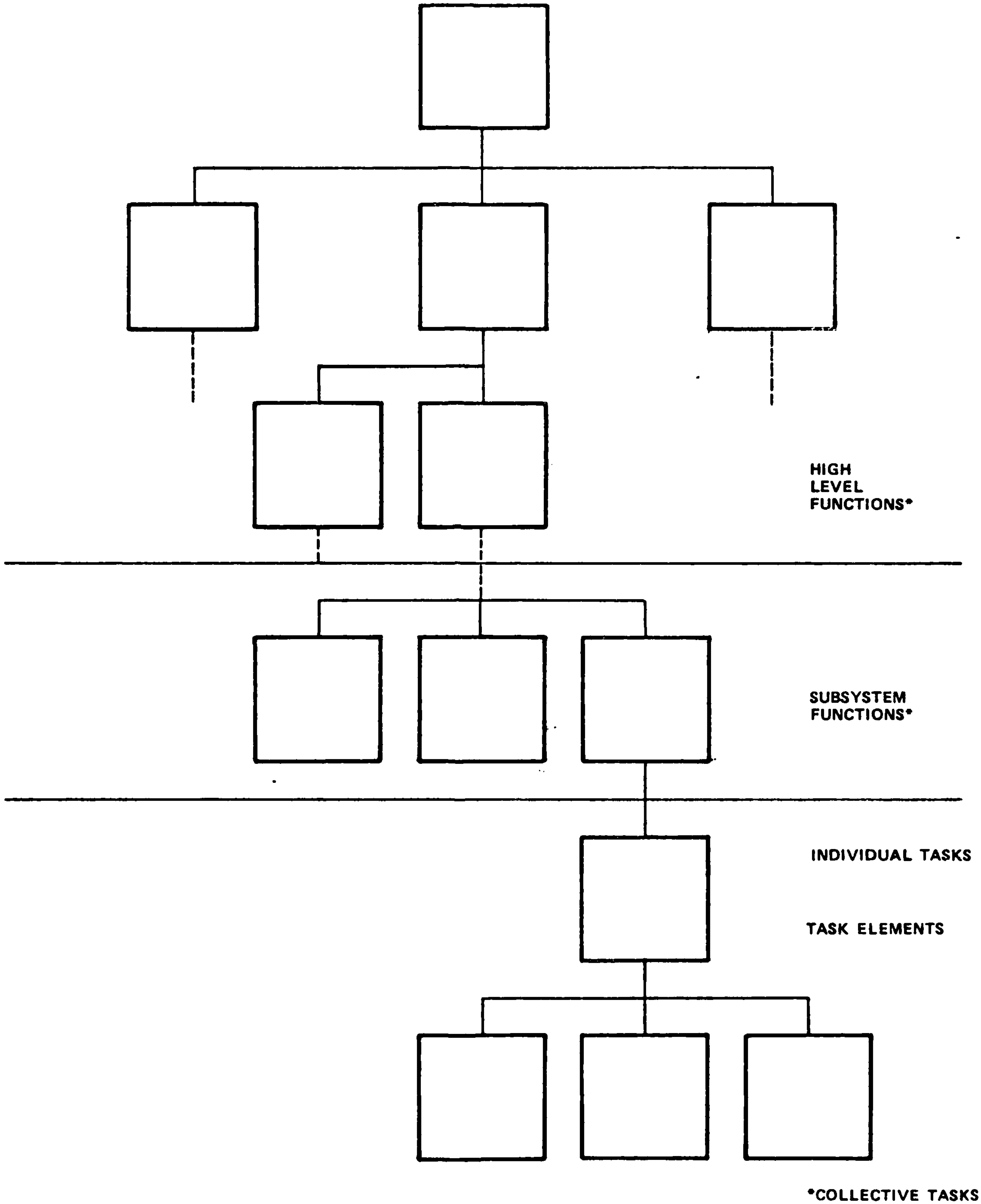

Figure 2-9 Overview of Relationship Between Subsystem Functions, Collective Tasks And Individual Tasks

TABLE 2-8 MAINTENANCE ACTIONS

a. INSPECT. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards, through examination.

b. SERVICE. Operations required periodically to keep an item in proper operating condition; i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluid , or compressed air supplies.

c. TEST. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

d. ADJUST. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. ALIGN. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. CALIBRATE. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. INSTALL. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. REPLACE. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. REPAIR. The application of maintenance services or other maintenance actions to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item or system.

j. OVERHAUL. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. REBUILD. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to the Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

often included in the MAC. A sample MAC is provided in Table 2-9. If a MAC is not available, the user should consider developing a preliminary MAC as an aid to maintenance task identification. MACs from comparable existing systems provide a starting point for development of a preliminary MAC.

It is possible that a New subsystem may require the same task as a BCS subsystem. The essential characteristics of this task, however, must frequently be changed to reflect the New system requirements. For example, the same task may be required for both the BCS and New system but the frequency with which the task is performed may vary significantly between the BCS and New systems. The task may have to be performed with greater frequency in the BCS than in the New system due to use of superior materials and lubricants in the New system. To account for these changes to essential task characteristics, all tasks with major modifications must be identified and the reason for the task modification must be documented using the code listed in Table 2-7. Tasks associated with major changes to skills and knowledges (i.e., tasks) in the MAJ category are analyzed further in Procedure 3.2 to identify the specific skill and knowledge differences between the BCS and New system tasks. Tasks with minor changes in task elements are not examined further (it is assumed that their skills and knowledges have not changed). The task addition, deletion, and modification codes should be entered in columns (q), (r), and (s) of the NTA worksheet.

Once tasks have been identified, their conditions and standards should be developed using existing instructional systems development procedures from the source documents

TABLE 2-9 EXAMPLE MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maintenance function	(4) Maintenance level					(5) Tools and equipment	(6) Remarks
			C	O	F	H	D		
05	COOLING SYSTEM—Cont								
0505	Fan Tower Assembly	Inspect		0.2					
		Test		0.2					
		Replace			3.0			35	A
		Repair		4.5				37	
		Overhaul					**		
06	ELECTRICAL								
0601	Alternator	Inspect		0.2					
		Test		0.2					
		Replace		2.0					B
		Repair			8.0				
		Overhaul					**		
0602	Voltage Regulator	Inspect		0.2					
		Test		0.2	0.7				
		Replace		2.0					
		Repair			1.0				
0603	Motor, Starting	Inspect		0.2					
		Test		0.2					
		Replace		2.0				49	
		Repair			2.4				
		Overhaul					**		
0607	Control and Indicator Panel	Inspect		0.2					
		Test		0.2					
		Replace		0.2					
		Repair		4.0					
0608	Power Supply, IR (Driver)	Inspect		0.2					
		Test		0.2					
		Replace		2.0					
		Repair		4.0					
	Box, Interphone, External	Inspect	0.2						
		Replace		2.0					
		Repair		2.0					
0609	Domelights	Inspect	0.1						
		Replace		0.7					
		Repair		1.5					
	Lights, Head and Tail	Inspect	0.2						
		Adjust		0.5					
		Replace		1.5					
		Repair		2.0					

** Worktimes are included in DMWR

specified in Table 2-3. These same procedures can be used to assess the adequacy of any new task descriptions which are generated during comparability analysis.

The completed New system list should be presented to the Program Office and cognizant school for review.

To complete this procedure, relevant task data should be entered into the SDT. Table 2-10 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide. Remember that separate SDT data bases should be maintained for the BCS and New system.

2.5 ASSIGN NEW SYSTEM TASKS TO MOS, DUTY POSITION AND SKILL LEVEL

OVERVIEW

During this procedure, the New system tasks are assigned to MOS, duty position, and skill level. Comparability analysis is used as the primary mechanism for making these assignments. Comparability analysis provides rough-cut assignments that are only appropriate for the earliest phases of the acquisition process.

PROCEDURE

An overview of the steps in this procedure is provided in Figure 2-10. During the first step, a duty position structure is identified for the New system. In the second step, the BCS tasks are assigned to duty position and skill

Table 2-10. Guidelines for Entering Data Into SDT (2.4)

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
2.4	New System Task Numbers	Tasks	NTA	L	2
2.4	New System Task Names	Tasks	NTA	M	1

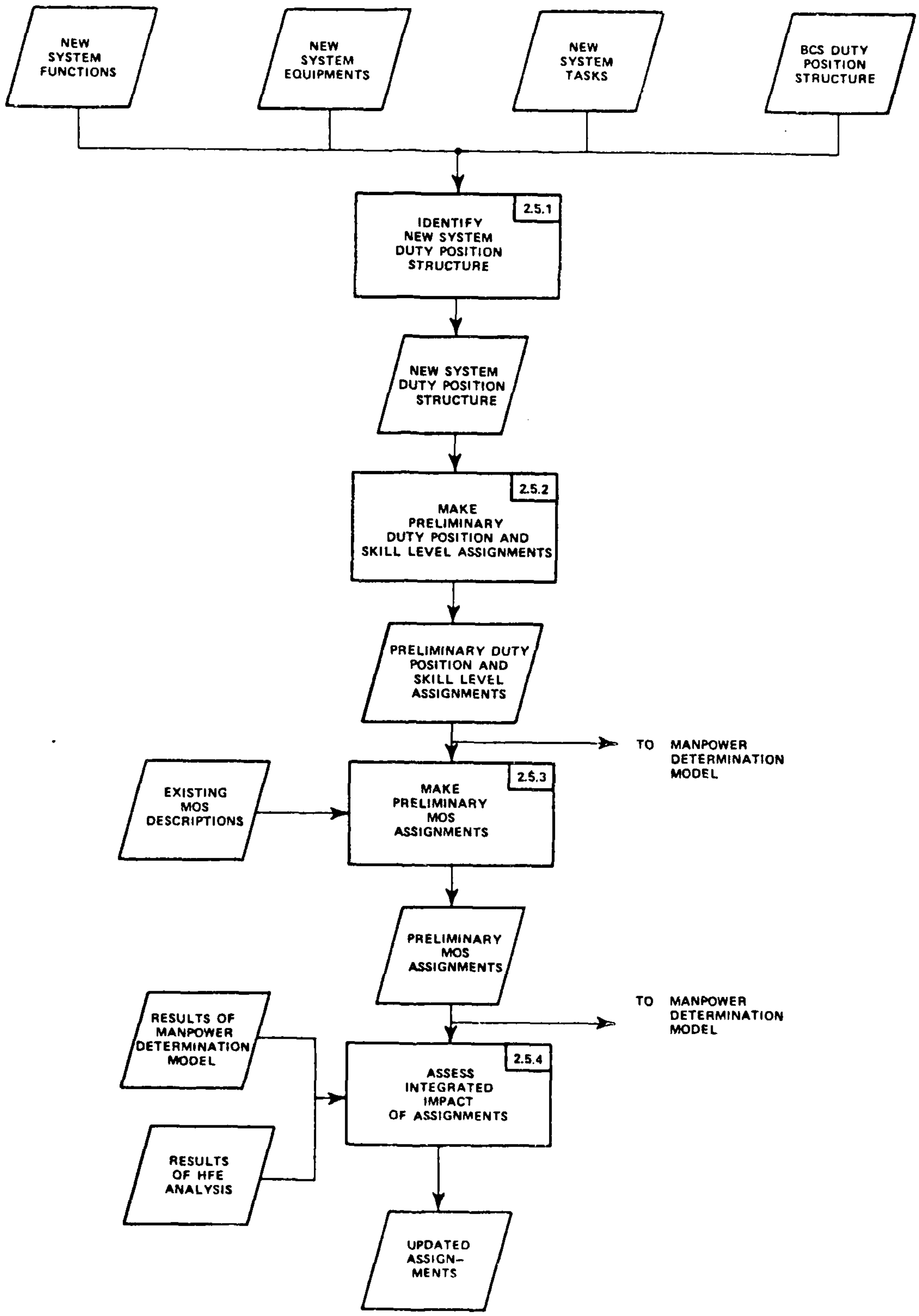

Figure 2-10. Overview Diagram: Assign New System Tasks to MOS, Duty Position, and Skill Level (2.5).

level. In the third step, duty positions are assigned to MOS. In the fourth step, the MOS, duty position, and skill level assignments are reviewed to take into account any manpower or human factors analyses which may have been conducted during the early phases of the acquisition program. The NTA worksheet used in Procedure 2.4 to describe New system tasks is also used in this procedure to describe MOS, duty position, and skill level assignments.

2.5.1 Identify Duty Position Structure

A duty position structure may be defined as a listing of the number and type of each duty position associated with a system. Construction of a New system duty position structure occurs in two steps. First, the duty position for the BCS system is examined. Second, duty positions are added or deleted from the BCS list to reflect the equipments or functions that were added/deleted to the BCS system to form the New system.

2.5.2 Assign Tasks to Duty Position and Skill Level

Assignment of tasks to duty position and skill level involves a three step process. First, the New system task list must be examined to identify any tasks which are associated with duty positions (or billets if a Navy system is involved) which are not in the New system duty position structure identified in 2.5.1. The user must then identify what New system duty positions would be most likely to perform the tasks associated with each of these other duty positions. This is accomplished by comparing the tasks already associated with the New system duty positions and the tasks associated with the other duty positions.

Second, all tasks should be assigned to a New system duty position. If the task is already associated with a New system duty position, then that duty position should be assigned to the task. If it is not currently assigned to a New system duty position, it should be assigned to the New system duty position which is most similar to the duty position from which it was derived.

Third, each New system duty position should be assigned a skill level. This is accomplished by identifying similar duty positions in the predecessor of other similar systems and assigning the New system duty position the skill level associated with that duty position.

2.5.3 Assign Tasks to MOS

Tasks are assigned to MOSs by comparing the tasks associated with the duty position to the task requirements of existing MOSs which are relevant to the New system. Task requirements for MOSs can be identified by examining (a) AR 611-201 which describes the MOSs and (b) the Soldier's Manual for each specialty which provides detailed data on MOS tasks.

If none of the MOSs listed in AR 611-201 match the task requirements of the New system, it may be necessary to establish requirements for a new MOS. Whenever possible, an existing MOS should be used due to the significant cost of establishing a new MOS. New MOSs should be designated by the terms X1, X2, X3 etc. in place of the two digits normally used to designate an MOS. More details on the requirements for establishing a new MOS are found in AR 611-1.

2.5.4 Assess Integrated Impacts of Assignments

Concurrent with an early training estimation study, there may be additional studies assessing the system manpower or human factors requirements. If there are such studies, the MOS, duty position, and skill level assignments developed in the previous step should be updated to reflect the more detailed input that these manpower and human factors studies typically provide. (Such studies typically assess the workload of operators and maintainers and this workload data provides more definite information on what tasks can be performed by each duty position).

After the New system skill level, duty position, and MOS assignments have been finalized, they should be entered into columns (e), (m), and (n) of the NTA worksheet, respectively.

2.5.5 Document Data

Relevant data collected or developed in this procedure must be entered into the SDT. Table 2-11 describes the sequence with which these data should be entered into the SDT. Additional guidelines for entering data into the SDT are contained in the SDT User's Guide. Remember that separate SDT data bases should be maintained for the BCS and New system.

Table 2-11. Guidelines for Entering Data Into SDT (2.5).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
2.5	New System Duty Position	Duty Position	NTA	N	1
2.5	New System Skill Level	Duty Position	NTA	O	1
2.5	New System MOS	Duty Position	NTA	P	1
2.5	New System Task-Duty Position Relationships	Duty Position	NTA	M,N	2
2.5	ASI	Duty Position	--	--	3(optional)
2.5	Position Type	Duty Position	--	--	3(optional)
2.5	Organizations	Duty Position	--	--	3(optional)

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SECTION 3 - ESTIMATE TRAINING PROGRAM

OVERVIEW

During this procedure, an estimate of the institutional training program is developed for both the Baseline Comparison System (BCS) and New System. The major products of this procedure are (1) quasi-program of instructions which outline the contents, methods, and media to be included in each institutional training course and (2) training paths describing the sequence with which these courses must be taken in an MOS.

PROCEDURE

This procedure consists of eight lower level procedures (See Figure 3-1). During this first procedure, tasks requiring training are identified. During the second procedure the tasks are assigned to training settings. In the third procedure, the general skills and knowledges associated with the tasks to be trained are identified. In the fourth procedure, a target population description is developed. In the fifth procedure, the sequence in which the tasks will be trained is identified. In the sixth procedure, quasi-program of instructions are constructed. In the seventh procedure, the automated Media Selection Program is used to assign tasks to media. In the eighth procedure, training paths are identified. It should be noted that the present version of ETES only estimates training programs for individual <u>institutional</u> training courses.

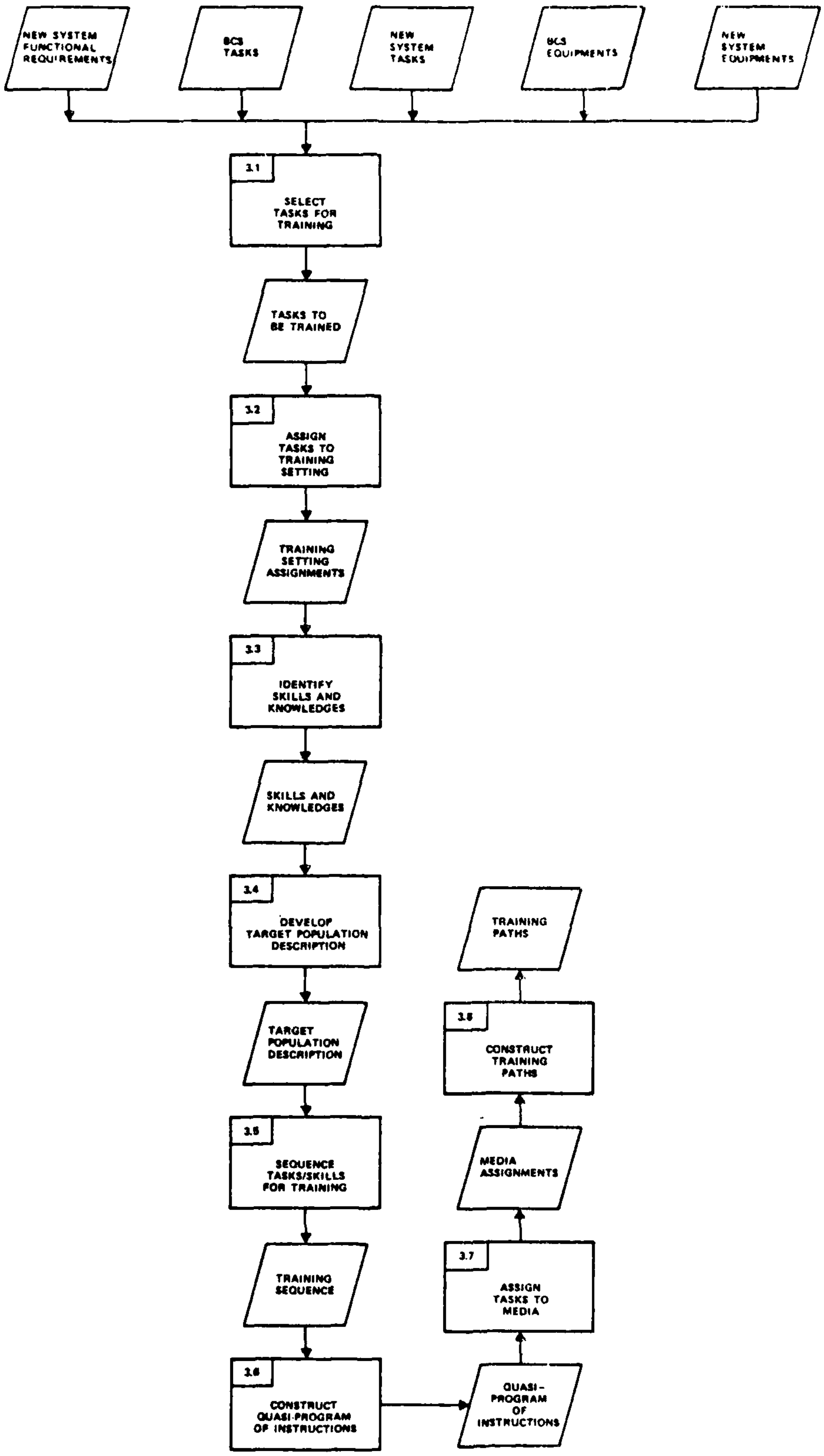

Figure 3-1 Overview Diagram: Estimate Training Program

3.1 SELECT TASKS FOR TRAINING

Once a task inventory has been compiled, the tasks in this inventory must be analyzed to determine which tasks require training. Since the task inventory for the typical MOS is composed of several hundred tasks, it is inappropriate to even consider training all of these tasks. Thus, the Army cannot formally train the individual soldier on all of the tasks required for full job proficiency. Even if the resources were available such a strategy would not be cost efficient considering the relatively low rate of soldier reenlistment and career progression.

This procedure describes how to select tasks for training (or conversely, to identify tasks which will not require training). This procedure provides several alternative methods for making the train-no train decision. These methods differ in terms of (1) the criteria used to select tasks for training and (2) the techniques used to aggregate the scores on the criterion variables. An overview diagram depicting the steps contained in this procedure is presented in Figure 3-2. Procedure 3.2, Assign Tasks to Training Settings, will assign the tasks to be trained to training settings. The major steps in the task selection process include choosing a task selection and aggregation method, obtaining task factor ratings/scores, applying criterion/ cutoff scores to develop a tentative task list for training, reviewing these tasks before making final task selections, and documenting the data associated with the procedure.

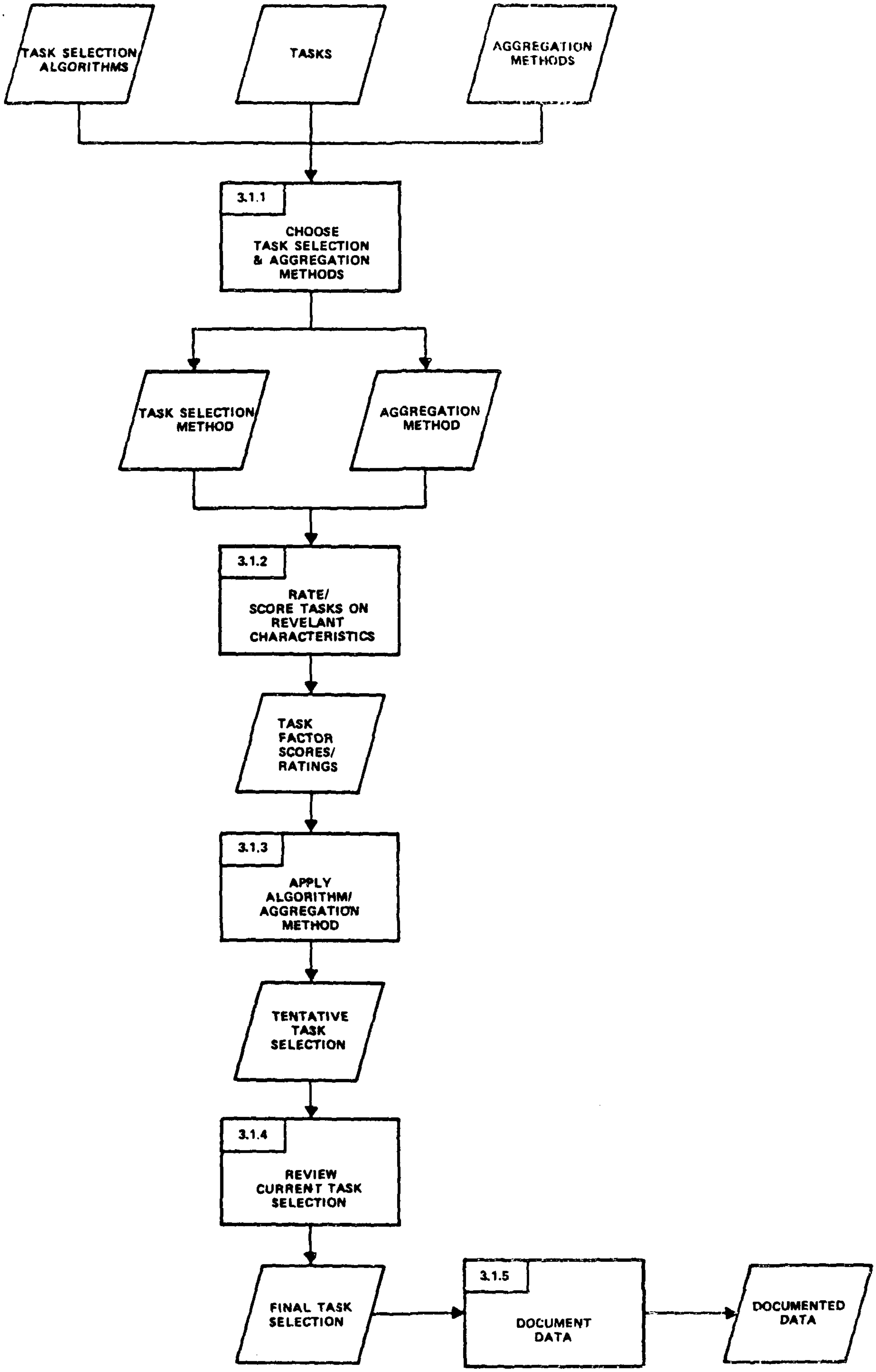

Figure 3-2 Overview Diagram: Select Tasks for Training

3.1.1 Choose Task Selection and Aggregation Methods

OVERVIEW

There is no single task selection method which can meet the needs of the different phases of the acquisition process and be effectively applied across all occupational specialties. Selection of tasks for training requires a management decision based on the best data available. A number of alternative methods have merit and, depending on the characteristics of the specialty analyzed and the requirements of the analysis, may be appropriate for task selection. A summary of these methods is provided in Table 3-1. An overview of procedure 3.1.1 is provided in Figure 3-3.

PROCEDURE

3.1.1.1 Identify Task Selection Requirements

In order to choose a task selection methodology for a particular application the user must determine the (1) accuracy requirements, (2) the data availability, and (3) resources available to conduct the analysis.

During the earliest phases of system acquisition, when several alternative system concepts are still being considered, a high degree of accuracy may not be required. The optimal approach may be one with moderate accuracy and low data requirements, that is, a "quick and dirty" approach.

During the later phases of system acquisition, when the accuracy of results is critical for training resource requirements analysis, more data intensive and accurate methods may be preferable.

Table 3-1. Overview of Task Selection Methods.

Method	Criteria	Data Requirements	Accuracy	Recommended Timing of Application	Comments
Comparability Analysis	• Comparable Existing tasks	• Low • Based entirely on existing data	• Depends on accuracy of task selection of comparable tasks	• Early in acquisition process	
DIF Model	• Difficulty • Importance • Frequency	• Moderate • Requires small sample • Analysis is simple	• Somewhat crude	• In early or middle phases of acquisition	
4—Factor	• Percent performing • Task delay tolerance • Task learning difficulty • Consequences of inadequate performance	• Fairly High • Large samples required • Complex data analysis	• Fairly comprehensive	• In latter phases of acquisition	
8—Factor	• Percent performing • Task delay tolerance • Task learning difficulty • Consequences of inadequate performances • % time performing • Frequency • Probability of deficient performance • Immediacy of	• High • Large samples required • Complex and Extensive data analysis	• Comprehensive	• In latter phases of acquisition	

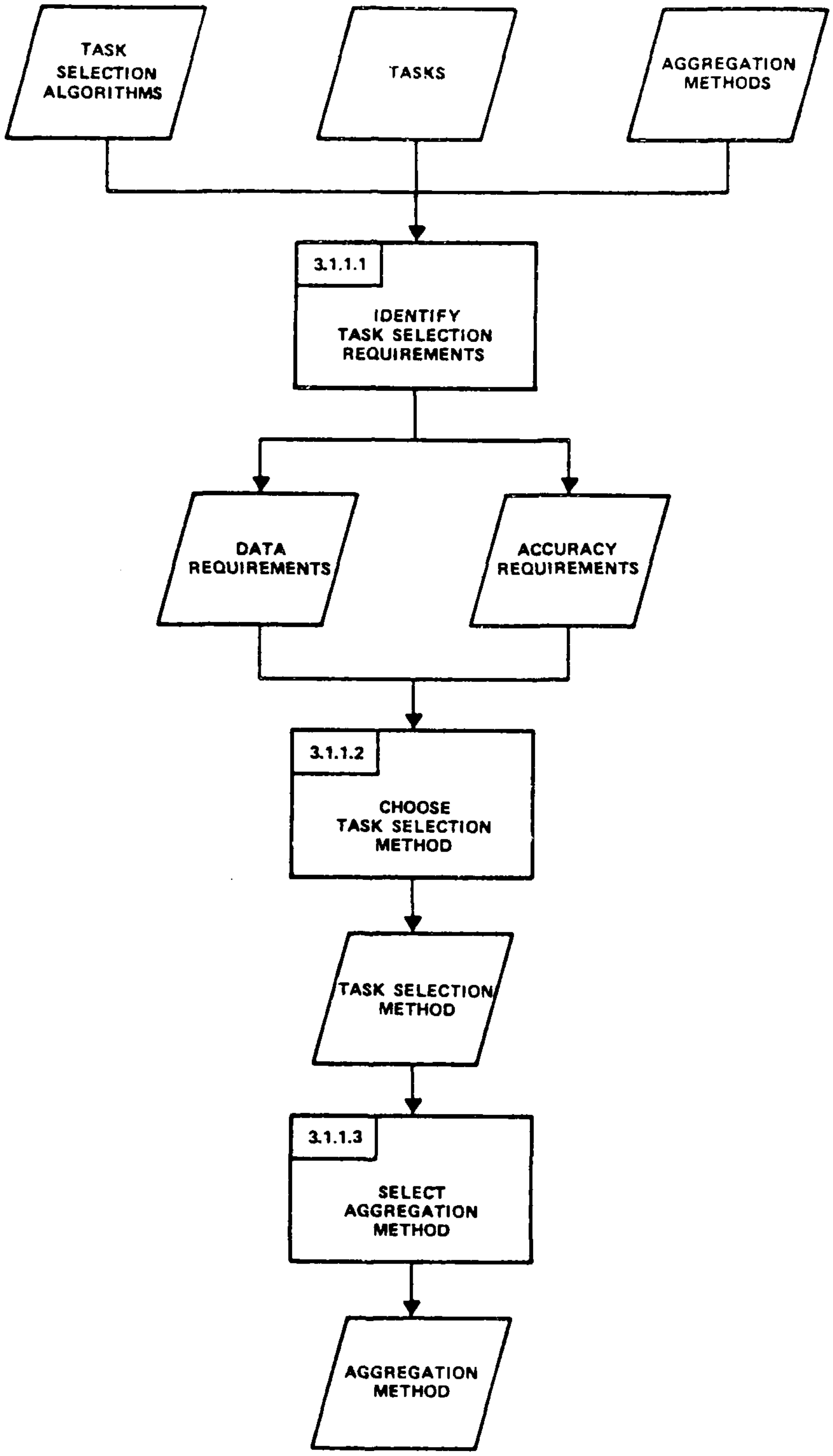

Figure 3-3 Choose Task Selection and Aggregation Methods (3.1.1)

Thus, the determination of the data and accuracy requirements of a study must precede the selection of an approach to task selection.

3.1.1.2 Choose Task Selection Method

Four task selection methods are presented in Table 3-1. These methods are described in terms of (1) their data requirements and (2) their estimated accuracy. For example, comparability analysis has the fewest data requirements and can therefore be applied early in the acquisition process. However, the accuracy of the results does not compare favorably with the alternative methods. Thus, comparability analysis should be used only when a quick and inexpensive analysis is required in the very earliest period of the acquisition process. The other methods listed in Table 3-1 have progressively increasing data requirements and corresponding improvements in analysis accuracy. These methods are described in the paragraphs which follow.

- Comparability Analysis

Comparability analysis may be used to provide crude task training assignments during the early phases of the acquisition process. The first step in the application of comparability analysis is to identify a comparable existing task for each of the tasks in the New System. A comparable existing task may be defined as a task which (1) is performed on comparable equipment or (2) involves the same type of task action (that is, the action verb for the comparable task matches or is highly similar to the action verb for the New system task).

The second step in comparability analysis is to assign the New system task to the same training categories (training, no training) assigned to their comparable tasks.

- DIF Model[1]

Another strategy for selecting tasks for training is a scheme called the DIF (Difficulty, Importance, Frequency) analysis. This methodology is a simple approach to a complex problem, in that it integrates several different criteria during the task selection process separately. The supervisor and incumbent are asked to determine the difficulty of the task in terms of learning and performing, then asked to comment on the importance of the task, and finally to estimate the frequency of task performance.

In determining the "difficulty" of the task, these responses encompass both task learning difficulty and probability of deficient performance. For the decision on "importance" the respondents' conscious or unconscious responses may well include factors such as the sequences of inadequate performance, the task delay tolerance, percent performing, and time spent performing. When estimating the "frequency", both frequency data and the time between job entry and task performance might be considered.

This approach to task selection implies that asking the supervisor and the job incumbent three simple questions will facilitate the task selection process. This approach has

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1 The descriptions of the DIF, Four Factor Model and Eight Model presented in this section were derived from TRADOC PAM 351-4.

merit because of its simplicity yet degree of precision it may achieve. The survey would be conducted by the service school (field surveys) and requires a relatively small sample (40 incumbents and 40 supervisors). A graphic portrayal of this sequence is described in Figure 3-4.

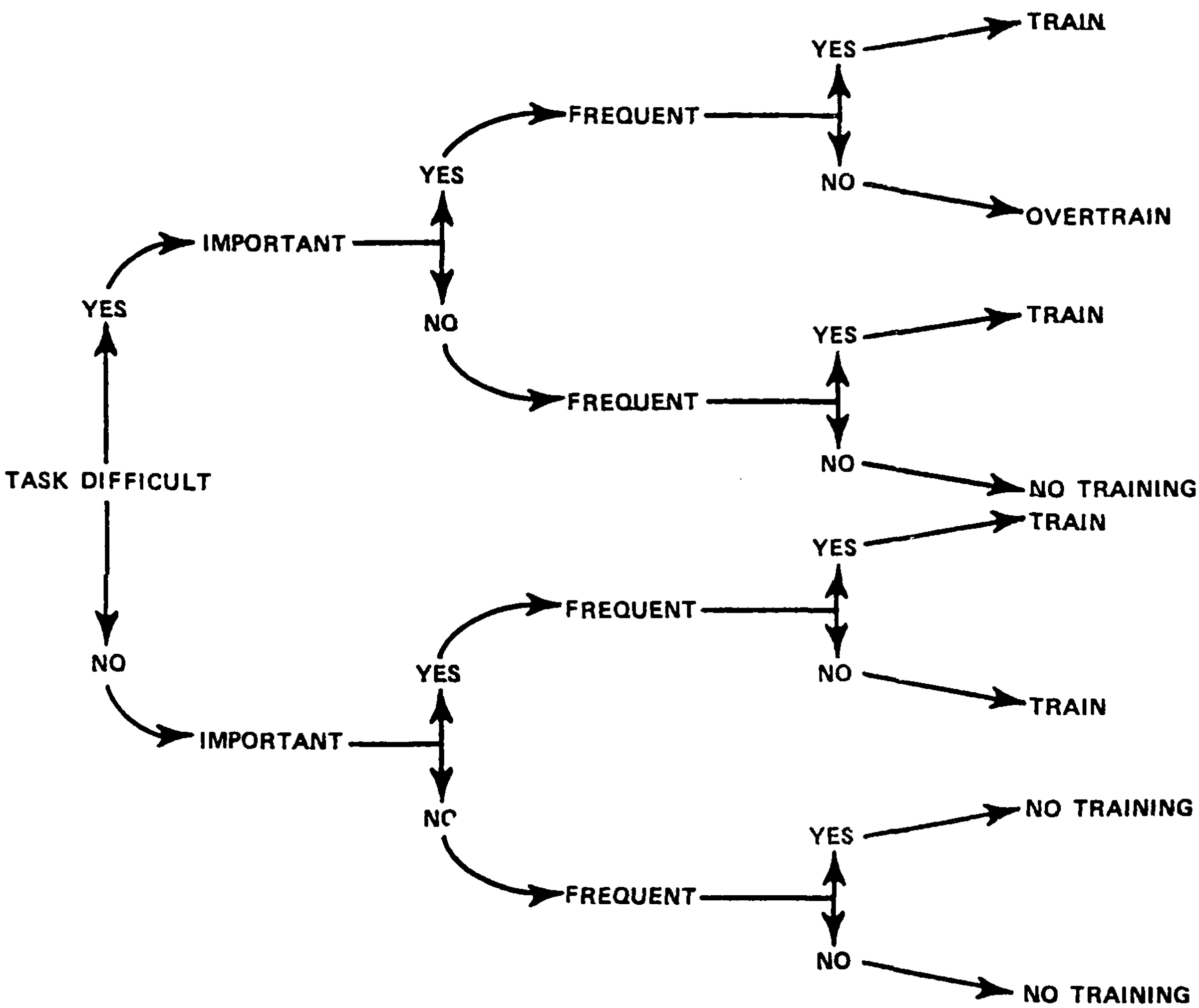
After going through this branching process it can be seen that at one end of the scale are different, important, and infrequently performed tasks. Each of these instances has a different rationale for whether to train the tasks. The sophistication and sensitivity of this technique can be increased by incorporating degrees of importance, difficulty, and frequency, and by using more detailed levels of training as shown in Figure 3-5.

- 4-Factor Model

The 4-Factor Model for task selection consists of four criteria for task selection that might influence the selection of tasks for training. These criteria are:

- Percent performing,
- Task delay tolerance,
- Task learning difficulty, and
- Consequences of inadequate performance.

Information on these four-factors is collected from job holders. Information can be collected directly by the analyst or from surveys administered by the Army Occupational Survey Program (AOSP) of MILPERCEN. Once information has been collected for each of the four factors for every task on the task inventory, there will be a large data base to use for selecting tasks for training. These



Train - Trainee must be able to demonstrat~ proficiency in performing task at speed required on the jo'..

Overtrain - Trainee must be trained to a high standard of retention. Accomplished by reinforcement training.

No Training - Formal training not required. Skills can be acquired on the job.

Figure 3-4 DIF Model

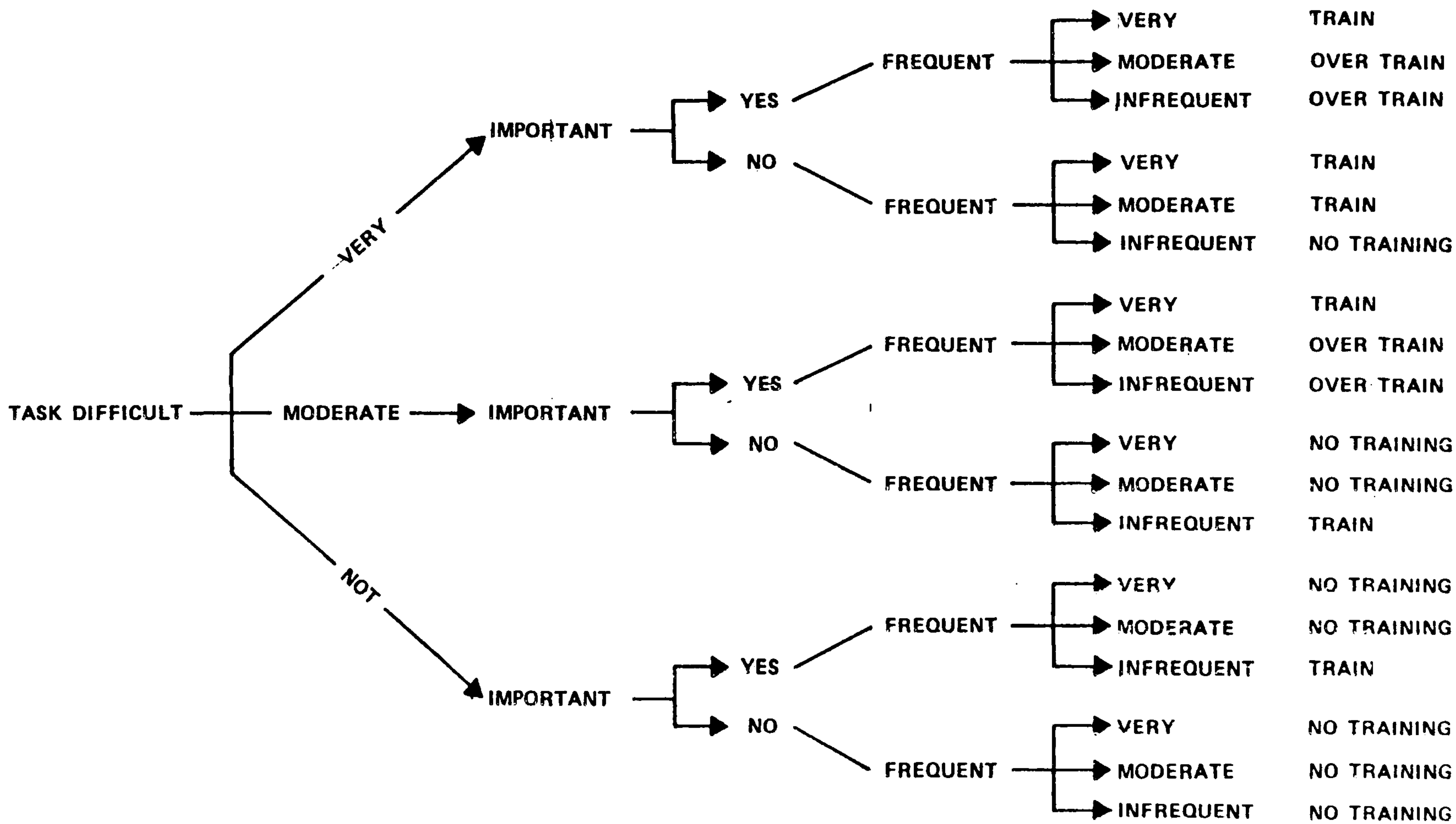


Figure 3-5 Detailed DIF

factors are summarized in Table 3-2 and are described in more detail in Procedure 3.1.2.

- o 8-Factor Model

The 8-Factor Model contains eight criteria including those comprising the 4-Factor Model. The additional four criteria are:

- o Percent of time spent performing,
- o Frequency of performance,
- o Probability of deficient performance, and
- o Immediacy of performance or time between job entry and task performance.

As in the 4-Factor Model, information can be collected from job holders directly by the analyst or from AOSP surveys. The 8-Factor Model provides a more comprehensive basis for selecting tasks for training than does the 4-Factor Model, but, as stated earlier, requires more extensive data collection. The factors listed above are described in more detail in Procedure 3.1.2.

Selecting tasks for training is probably the most important management decision made early in training design. The tasks selected for training (1) provide the specialty base, (2) drive the production of training materials, Soldier's Manuals, SQTs, and (3) are the basis of the specialization within each specialty. If all tasks cannot be trained, then the tasks that are trained must be the right ones in terms of job proficiency, transferability, and combat criticality. Each of these models described above requires a different amount of analysis effort and time. Each model has certain

Table 3-2. Data Sources for 4-Factor Model

Task Selection Factor	Source
- Percent Performing	Percent of soldiers surveyed who indicate they perform the task
- Task Delay Tolerance - Task Learning Difficulty - Consequences of Inadequate Performance	Average of responses from 1(low) - 7(high) indicated by soldiers surveyed who perform the task

advantages and limitations such as ease of use, acceptability by field, comprehensiveness, timeliness, etc.

Based on the data requirements of the alternative selection methods, the accuracy requirements of the task selection process, and an understanding of the differences among the alternative procedures, the analyst must choose a task selection method.

3.1.1.3 Select Aggregation Method

In each alternative task selection procedure, some method must be used to aggregate data. Thus, in the eight factor model for example, ratings on eight criteria have been obtained for each task. These ratings must be combined to yield a single measure of the requirement for training.

Because of the comprehensiveness and complexity of the factors, it is not easy to simply combine all factors and pick the most important tasks for training. One aggregation strategy requires the command to designate the most important factor(s). A value is specified as a cutoff point for that factor. If a task is above that cutoff point on that factor, it is selected for training. All the factors can then be considered, with respective cutoff scores indicating the most important tasks.

For example, for combat tasks, the factor of Consequences of Inadequate Performance may be important. Thus any task over 6.0 (series) would be selected. Perhaps the commander might also feel that a large percentage of performers indicates a task should be trained. Thus, only tasks with over 50% of the incumbents performing would be selected for training.

Combining these two cutoff scores would mean that all tasks performed by 50% of the soldiers and/or scoring 6.0 or higher on Consequences of Inadequate Performance would be selected for training (Note that the establishment of the cutoff point is somewhat arbitrary).

Alternatively, a method can be devised for aggregating a set of ratings on task factors to form a summary index of training priority for each task.

Tasks are then rank ordered by the training priority index and cutoff values are established indicating the number of tasks that will receive initial training in institutional courses. Cutoff values can be developed by first examining the number of tasks currently assigned to each training setting in the MOS (this information can be obtained from the Trainer's Guide for the MOS). For example, the Trainer's Guide might indicate that 30 tasks currently receive initial training in institutions. The cutoff values that are currently employed in the MOS must then be examined and updated to reflect (1) projected resource constraints in each training setting, and (2) major changes in the learning difficulty of the tasks. Initial assignments to institutional training and no training categories are made by applying the cutoff values to the training priority rankings.

Table 3-3 contains a list of alternative algorithms for aggregating task factor data. Table 3-4 indicates which algorithms for aggregating task factors are appropriate for each task selection model.

Table 3-3. Potential Algorithms for Aggregating Task Factors

Weighted Z Scores

$$TPI = \sum_{I=1}^{n} W_i \, Z_{ij}$$

where TPI is the training priority index; W is the weight assigned to the i the task factor; and Z_{ij} is the Z score of the i^{th} task on the j^{th} factor; and N is the number of task factors.

$$Z_{ij} = \frac{X_{ij} - X_j}{SD_j}$$

where X_{ij} is the raw score of the i^{th} task on the j^{th} factor; X_j is the mean of the X_{ij} for the j^{th} factor; and SD_j is the standard deviation of the X_{ij} for the j^{th} factor.

Individual Task Factor Criteria

In this method, cut points are established for individual task factors. Thus, for example, a cutoff point of 6.0 could be established on the factor, consequences of inadequate performance. As a result, any task with task factor scores exceeding 6.0 would be selected for training. Similar criteria could be established for other task factors.

e.g., Select for training if:
$\geq$ 6.0 on Task Factor 1
$\geq$ 5.0 on Task Factor 2
$\geq$ 5.0 on Task Factor 3

Evaluate each task against criteria for each task factor.

Task Factor Criteria Algorithms

A task factor criteria algorithm specifies, for a particular combination of values on task factors, whether a task should be trained. Such algorithms are not really used to aggregate task factor scores as much as to lead the analyst to a solution.

Table 3-4. Appropriate Aggregation Algorithms for Alternative Task Selection Models.

Aggregation Algorithms / Task Selection Model	Weighted Z Scores	Individual Task Factor Criteria	Simple Weighting	Task Factor Criteria Algorithms
Comparability Analysis				
DIF				
4 Factor				
8 Factor				

3.1.2 Rate/Score Tasks on Relevant Characteristics

OVERVIEW

During this procedure, methods are designed to collect data on the task factors required for the method selected in Procedure 3.1.1.2 and the data are collected and compiled. An overview of the elements comprising this procedure is depicted in Figure 3-6.

3.1.2.1 Design Methods for Rating/Scoring Tasks

PROCEDURE

In this step, methods for rating/scoring tasks are devised, based on the task selection method being used. Procedures for each task selection method are described below.

- <u>Comparability Analysis</u>

When using comparability analysis no ratings/scores are obtained on tasks. The user can proceed to Procedure 3.1.3.

- <u>DIF Algorithm</u>

An example of a data collection format which can be used to employ the DIF model is presented in Figure 3-7. A series of three questions is presented to job incumbents/ supervisors in the sequence shown in the figure.

Of course, this format should be tailored by each proponent school to meet its specific needs.

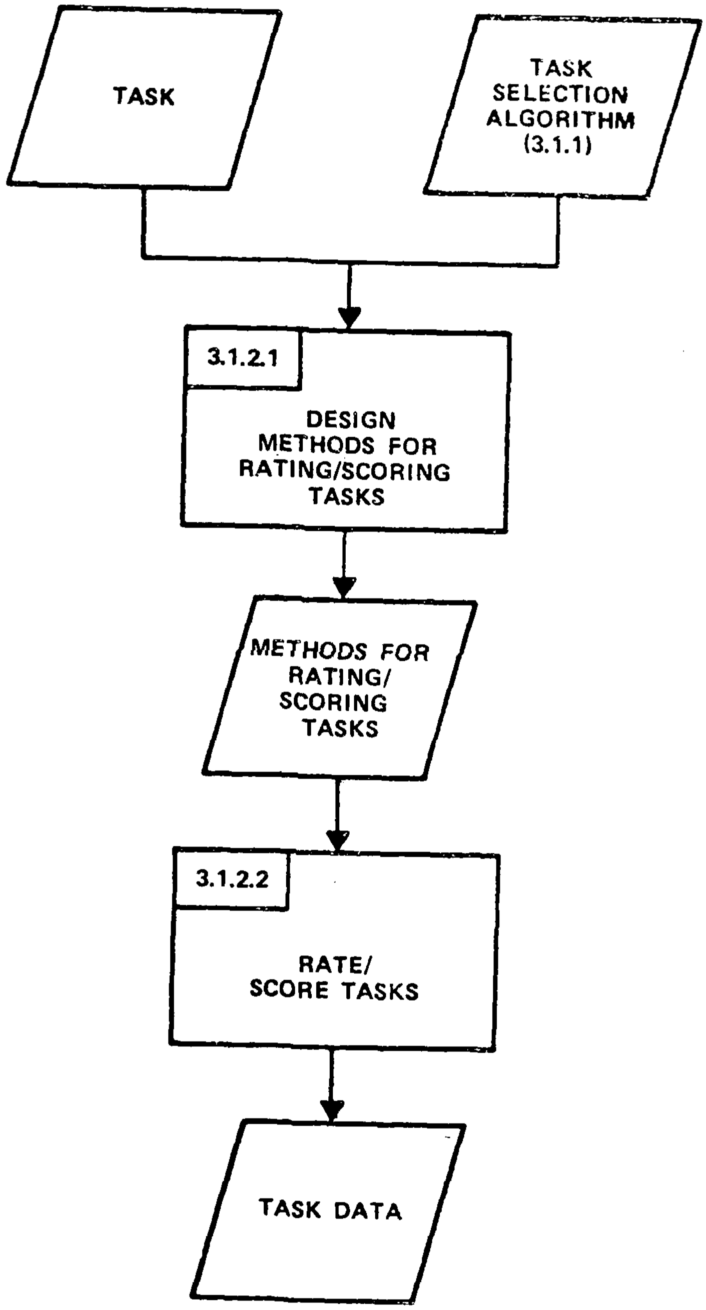


Figure 3-6 Rate/Score Tasks on Relevant Characteristics (3.1.2)

	JOB INCUMBENT'S RESPONSE—				SUPERVISOR'S RESPONSE			
TASK	IS TASK DIFFICULT?	HOW IMPORTANT IS TASK IN YOUR JOB?	HOW OFTEN DO YOU DO THIS TASK?	COMMENTS:	DO YOUR PERSONNEL FIND TASK DIFFICULT?	HOW IMPORTANT IS TASK IN JOB OF PERSONNEL YOU SUPERVISE?	HOW OFTEN DO THE PERSONNEL YOU SUPERVISE PERFORM THIS TASK?	COMMENTS:
X								
Y								
Z								

NOTES:

1 TOTAL NUMBER OF INCUMBENTS AND SUPERVISORS MUST BE DESIGNATED BY PROPONENT SCHOOL.

2 IF POSSIBLE DETERMINE WHAT WAS DIFFICULT: LEARNING? PERFORMANCE?

3 THIS SCALE MUST BE DETERMINED BY PROPONENT SCHOOL. A NOTIONAL CATEGORY COULD BE:
   a. VERY FREQUENT—NEARLY EVERY PROJECT.
   b. MODERATE FREQUENCY—+1 X PER WEEK.
   c. INFREQUENT—+1 X PER MONTH.

Figure 3-7 DIF Data Collection Format

o 4-Factor Model

Data must be obtained on the four factors in this model either from the Army Occupational Survey Program (AOSP) of MILPERCEN or directly from surveys administered to job incumbents/supervisors. Each of the four factors is described in detail in the following paragraphs.

Percent Performing

The criterion, "percentage of job incumbents who perform the task", indicates those tasks that are most often performed on the job.

For example, one task for weather technicians is "to answer telephone inquiries about the weather." If you found that 96 percent of all weather technicians performed this task, the implications for training would be different than if you found that only 10 percent performed it.

In the above example, if only 10 percent of job incumbents perform a task, there is a strong probability that 90 percent of your training resources would be wasted if you trained all weather technicians to perform the task. In order to obtain data for determining the percentage of job incumbents performing each task, simply ask "Do you perform this task?" or derive the percentage performing from answers to other related questions. If, for example, in collecting "frequency of task performance" data one of the possible responses is "never" or "do not perform", you will have the basic data for determining percent performing.

Task delay tolerance

The delay tolerance of a task is a measure of how much delay can be tolerated between the time the need for task performance becomes evident and the time the actual performance begins. There are some tasks normally encountered by job incumbents in which no such delays can be tolerated. The job incumbent who encounters the task must be capable of doing it then and there, without needing to read task procedures or finding someone to advise him or take over completely. For other tasks, a delay of a few minutes or perhaps half an hour might be quite acceptable, or even mandatory, while the job incumbent gets advice, checks technical orders, regulations, etc. And for some tasks, there might be time to assemble a group of experts to confer before proceeding. The delay tolerance of a task is a measure of how much delay can be tolerated between the time the need for task performance becomes evident and the time actual performance begins. The following are examples of low delay tolerance tasks requiring immediate performance.

EXAMPLES

1. Use artificial respiration to restore the breathing of an accident victim.
2. Pull ripcord of emergency parachute if main parachute fails.
3. Warn suspect of his legal rights before questioning.
4. Film historic occasion for official records.
5. Extinguish fire in aircraft engine during startup on flight line.

Tasks determined to have a low delay tolerance should be given relatively high priority for selection for training.

Examples of tasks having a higher delay tolerance, thereby permitting performance delay, would include:

EXAMPLES

1. Review books for unit library.
2. Refill fire extinguisher after use.
3. Advise major command of unit manning problem.
4. Fit microphones in aircrew oxygen masks.

A high delay tolerance does not exclude a task from training, but indicates that other factors will be more of a basis for acceptance or rejection. To obtain data on this criterion, individuals who are familiar with the job are asked to rate the amount of delay that can be tolerated before task performance begins, according to the categories listed below.

(1) Extremely low - performance can be put off indefinitely: almost never urgent.
(2) Low.
(3) Somewhat below average.
(4) Average.
(5) Somewhat above average.
(6) High.
(7) Extremely high - task performance must begin instantly.

<u>Task learning difficulty</u>

The learning difficulty of a task refers to the time, effort, and assistance required to achieve performance proficiency. Some tasks encountered in each specialty are so easy or so familiar that they can be readily "picked up" on the job without formal training. At the other extreme,

some tasks are so complicated that a job incumbent can perform them adequately only after a sustained period of formal training. Other tasks lie somewhere between these extremes and require different levels of training. Tasks easy enough to be "picked up" on the job without training might be:

EXAMPLES

(1) Sweep floors.
(2) Collect food trays from patients in hospital wards.
(3) Distribute unclassified correspondence in an office.

Tasks requiring lengthy, formal training might be:

EXAMPLES

(1) Diagnose malfunction in an airborne radar weapons system.
(2) Defuse unexploded enemy bombs.
(3) Identify parasites in clinical specimens.

To obtain data on the factor of task learning difficulty, job incumbents or supervisors might be asked to rate tasks as to the training time required to achieve proficiency, or as to the difficulty of "picking up" the task on the job without formal training. The following rating scale might be used:

(1) Extremely low - extremely easy to "pick up" without systematic training.

(2) Low.

(3) Somewhat below average.

(4) Average.

(5) Somewhat above average.

(6) High.

(7) Extremely high - extremely difficult to learn without systematic training.

Consequences of inadequate performance

The criterion of consequences of inadequate performance points to the need for selecting tasks for training that are essential to job performance, when needed, even if they are seldom performed. The consequences of inadequate performance on certain tasks could result in injury to personnel, loss of life, or damage to equipment. Inadequate performance could have a serious impact on the mission, the operation, the product, the equipment, or the operator.

EXAMPLES

(1) More and more electronic equipment is being transistorized and is therefore less subject to malfunction. This fact should reduce the amount of maintenance training that an operator requires. However, there may be a number of malfunctions that, although occurring very infrequently, would be extremely critical if immediate corrective action were not taken by the operator. Severe damage to the equipment, materials, or products might result. Under such circumstances, the criticality of the infrequently used tasks is so great that it must be considered in choosing tasks for training.

(2) The probable consequences of inadequate performance of such combat tasks as "identify enemy aircraft" could be loss of life and equipment.

(3) The probable consequence of inadequate performance of the task of "write trip report" is negligible. If this task were selected for training, it would be on the basis of factors other than probable consequences of inadequate performance.

To obtain data on this criterion, individuals familiar with the job are asked to rate probable consequences of inadequate performance of each task according to the categories listed below.

(1) Extremely low - if performed inadequately, consequences are negligible.
(2) Low.
(3) Somewhat below average.
(4) Average.
(5) Somewhat above average.
(6) High.
(7) Extremely high-inadequate performance may result in mission failure, injury, death, or damage to important equipment.

Tables 3-5 and 3-6 contain sample sets of data collection forms for the four factor model.

Table 3-5. Sample Collection Form Using 4-Factor Model.

TASK TITLE		PERCENT PERFORMING	TASK DELAY TOLERANCE (1=low,7=high)	TASK LEARNING DIFFICULTY (1=low, 7=high)	CONSEQUENCES OF INADEQUATE PERFORMANCE (1=low,7=high)
1.	PREPARE A MAP OVERLAY				
2.	DECONTAMINATE SELF & INDIVIDUAL EQUIPMENT				
3.	ENGAGE HOSTILE AIRCRAFT W/INDIVIDUAL WEAPON				
4.	PERFORM PM SERVICES ON AN/VRC 46 RADIO				
5.	REPAIR THE EXHAUST SYSTEM OF AN M151A1				

Table 3-6.

Sample Data Collection Form for Four Factor Model

Task Selection Survey for MOS <u>31M</u>

SOLDIER NAME ____________________ SSN ________________________

WHEN DID YOU COMPLETE OSUT/AIT TRAINING FOR YOUR MOS? __________________

GRADE ____________ TOE/TDA DUTY POSITION (JOB TITLE) ____________________

HOW LONG HAVE YOU BEEN WORKING IN YOUR PRESENT JOB? ________ MONTHS

The 31M Soldier's Manual lists, for each skill level, the tasks that each soldier is expected to perform on the job. In fact, you probably do not do all of these tasks in your present job. You may not have the equipment or you may specialize on the job.

- On the next few pages all tasks in your MOS are listed.
- Task statements are grouped under equipment area titles.
- Rate each task by circling the appropriate number to the right of each task statement.

Table 3-6. (Continued)

Percent Performing		
Task Title	Tasks You Perform Now in Your Job	Tasks You Do Not Perform In Your Current Job

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Table 3-6 (Continued)

Task Delay Tolerance							
Task	Extremely Low	Low	Somewhat Below Average	Average	Somewhat Above Average	High	Extremely High
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

Table 3-6 (Continued)

	Task Difficulty						
Task	Extremely Low	Low	Somewhat Below Average	Average	Somewhat Above Average	High	Extremely High
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

Table 3-6 (Continued)

	Consequences of Inadequate Performance						
Task	Extremely Low	Low	Somewhat Below Average	Average	Somewhat Above Average	High	Extremely High
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

o 8-Factor Model

Data collection for the 8-Factor Model is similar to that for the 4-Factor Model. Those factors in the 8-Factor Model which are not part of the 4-Factor Model are described in the following paragraphs.

Percent of time spent performing

The percent of time spent performing a task is a criterion suggesting that training be provided to assist job incumbents in efficiently performing their most time consuming tasks.

EXAMPLE

In the Protective Equipment/Pressure Suit Specialty, 6.67 percent of average time of all members is spent performing the task of "maintain rigid survival kits". Only 0.16 percent of average time is spent on the task of "install microphones in oxygen masks." If more effective training could increase productivity 50 percent in the first task, 3.33 percent of the total time of all members might be saved. This would represent a significant savings. However, if productivity were increased 50 percent for the second task. Only 0.08 percent of the total time would be saved. This represents a much smaller savings opportunity.

To obtain data for determining the percentage of time spent performing the tasks in a specialty, inputs are required from a large number of job incumbents. Usually they are not asked to state the percentage of their time spent on each task because such a question would be very difficult to

answer. Instead, they are usually asked to rate each task as to the amount of time spent performing it as compared to their other tasks.

EXAMPLE

You are to rate the relative amount of time you spend performing each task in your present job. Relative time spent means the total time you spend doing the task compared with the time you spend on each of the other tasks in your present job. The following scale might be used to rate the relative amount of time spent on each task:

1 very much below average.
2 below average time.
3 for slightly below average time.
4 for about average time.
5 for slightly above average time.
6 for above average time.
7 for very much above average time.

From the above information, a computer program such as MILPERCEN's Comprehensive Occupational Data Analysis Program (CODAP) can compute and print out the average percent of time spent by members of the specialty who perform the task, and the average percent of time spent by all members of the specialty.

Frequency of Performance

While the probable consequences of inadequate performance of a particular task are serious and the task delay tolerance in low, the task might still rate low for training priority if it is rarely performed.

EXAMPLE

For a medical corpsman, the task of "deliver baby" is so rarely performed that it probably would not be trained in spite of the serious consequences of inadequate performance and the relatively low task delay tolerance.

On the other hand, if a task is performed frequently, the pay-off in terms of return on training dollars expended is likely to be great, particularly if there is a known "best way" to perform the task. A practical way to collect frequency of performance data on tasks is to rate their frequency of performance on a scale such as the following:

(1) Never perform.
(2) Once a year.
(3) Once every three months.
(4) Once a month.
(5) Once a week.
(6) Once a day.
(7) Several times a day.

Probability of deficient performance

The criterion of probability of deficient performance insures that training is given in those essential job skills in which job incumbents frequently perform poorly. In any job, some tasks are more difficult to accomplish (or easier to bungle) than others. By tabulating the judgments of knowledgeable personnel regarding the probability of deficient performance, a list of these poorly performed tasks can be produced. Training of these tasks, regardless of their criticality, must be given serious consideration.

EXAMPLES

1. If equipment downtime is often caused by faulty soldering, this skill may require additional

emphasis in a list of tasks selected for training of repairmen.

2. If widespread theft of items guarded by military police is a problem, the task of "guard packages, materials, and property" and "prepare physical security plans" may require additional emphasis.

To obtain data on the criterion of probability of deficient performance, supervisors of job incumbents might be asked to rate each task as to how often, according to the scale below, subordinates in the MOS perform the task in an unacceptable manner:

(1) Very much below average.
(2) Below average.
(3) Slightly below average.
(4) Average.
(5) Slightly above average.
(6) Above average.
(7) Very much above average.

Immediacy of performance or time between job entry and task performance

The criterion of the time interval between completion of training and initial performance of the task on the job has some significance in selecting tasks for training. Here, the determining factors are:

(1) Whether or not there is a high probability of a graduate encountering the task on the job fairly soon after completing training. "Fairly soon" means, in this context, that task encountered within the first year after training would,

everything else being equal, be weighted more heavily for selection than those not encountered until one to two years later and

(2) The predicted or measured amount of decay of the skill that will take place during the time interval.

EXAMPLE

The ability to send and receive Morse Code is a relatively difficult skill to acquire. If the skill is not used, a considerable amount of decay is certain to occur. If the skill is only rarely needed by personnel, it may be wise to exclude the task in the training given to all trainees. However, if the skill is likely to be used immediately after graduation by most graduates, it probably should be included in the training for all trainees.

To obtain data on this criterion, job incumbents and others might be asked to rate the time between job entry and task performance on a scale such as that listed below.

(1) Task not yet performed.
(2) Task first performed more than 4 years after assignment.
(3) Task first performed between 2 and 4 years after assignment.
(4) Task first performed between 1 and 2 years after assignment.
(5) Task first performed between 6 months and 1 year after assignment.

(6) Task first performed between 3 months and 6 months after assignment.

(7) Task performed during first 3 months of assignment.

Sample data collection forms for those factors not included in the 4-Factor Model are presented in Table 3-7.

3.1.2.2 Rate/Score Tasks

During this procedure, data collection takes place using a minimum of 10 to 20 raters for each task. Additional raters may be required if the total number of judgments required of each rater becomes excessive. The number of judgments required can be computed by multiplying the number of task factors by tasks. Raters may experience fatigue after making several hundred judgments and the reliability of subsequent ratings may be unsatisfactory.

3.1.3 Apply Algorithm/Aggregation Method

OVERVIEW

During this procedure, data collected during Procedure 3.1.2 will be compiled and aggregated, task selection criterion/ cutoff scores will be developed, and tentative task selections will be made. An overview of this procedure is presented in Figure 3-8.

PROCEDURE

3.1.3.1 Apply Aggregation Method

In this step, data will be compiled and then aggregated using one of the methods depicted in Table 3-3. The

Table 3-7.

Sample Data Collection Form for Eight Factor Model

Task Selection Survey for MOS 31M

SOLDIER NAME ______________________ SSN __________________________

WHEN DID YOU COMPLETE OSUT/AIT TRAINING FOR YOUR MOS? ____________________

GRADE ______________ TOE/TDA DUTY POSITION (JOB TITLE) ________________________

HOW LONG HAVE YOU BEEN WORKING IN YOUR PRESENT JOB? _________ MONTHS

The 31M Soldier's Manual lists, for each skill level, the tasks that each soldier is expected to perform on the job. In fact, you probably do not do all of these tasks in your present job. You may not have the equipment or you may specialize on the job.

- On the next few pages all tasks in your MOS are listed.
- Task statements are grouped under equipment area titles.
- Rate each task by circling the appropriate number to the right of each task statement.

Table 3-7. (Continued)

	Percent of Time Spent Performing						
Task	Very Much Below Average	Below Average	Slightly Below Average	About Average	Slightly Above Average	Above Average	Very Much Above Average
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

Table 3-7 (Continued)

	Frequency of Performance						
Task	Never Perform	Once A Year	Once Every Three Months	Once A Month	Once A Week	Once A Day	Several Times A Day
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

Table 3-7 (Continued)

	Probability of Deficient Performance						
Task	Very Much Below Average	Below Average	Slightly Below Average	Average	Slightly Above Average	Above Average	Very Much Above Average
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

Table 3-7 (Continued)

Task	Immediacy of Performance or Time Between Job Entry and Task Performance						
	Task Not Yet Performed	More Than 4 Years	Between 2 and 4 Years	Between 1 and 2 Years	Between 6 and 12 Months	Between 3 and 6 Months	7 During First 3 Months
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

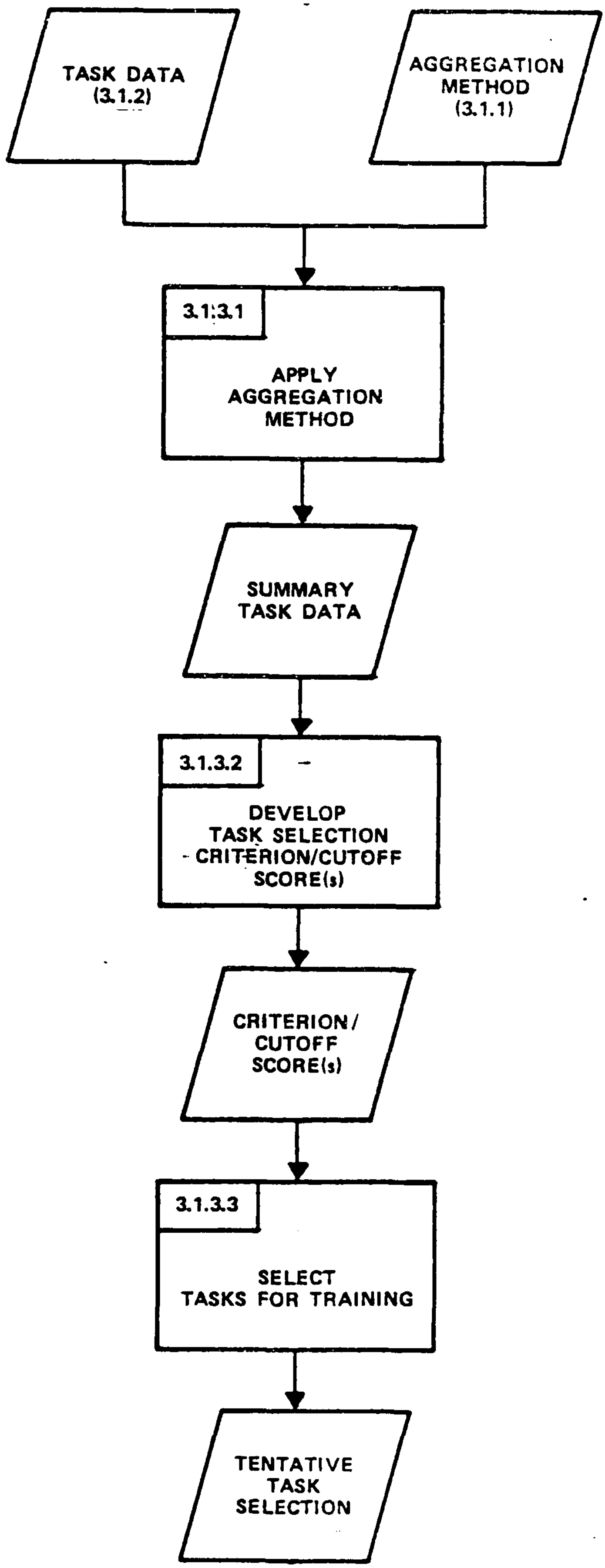

Figure 3-8. Apply Algorithm/Aggregation Method (3.1.3).

worksheets provided in Table 3-8 can be used to compile the data obtained in Procedure 3.1.2. These data should consist of mean ratings/scores on each task factor for each task. Thus, each entry to one of the worksheets in Table 3-8 will consist of the average rating/score obtained by one task on one task factor (sum across all raters and divide by the number of raters).

Secondly, an aggregation method (if appropriate) will be applied to the data contained in the worksheets, resulting in a summary score/rating for each task. Summaries of each of the data aggregation methods are contained in Table 3-3.

3.1.3.2 Develop Task Selection Criterion/Cutoff Score(s)

Criterion/cutoff scores are identified in this procedure that will be used to determine which tasks will be selected for training. These criterion/cutoff scores can be determined by:

(1) Using the number of tasks currently trained for a similar system. After determining the number of tasks on the similar system a cutoff point on the summary measure is set which selects the appropriate number of tasks for training.

(2) Examining available training resources to determine the available training time in various settings. This examination may reveal a limit on the number of tasks which can be selected for training. As a result, a cutoff point can be set which will produce the appropriate number of tasks.

Table 3-8 Data Summary Worksheets

Comparability Analysis (Comp)

SYSTEM ______________________________

(a) NEW TASK TITLE	(b) COMPARABLE TASK	(c) COMPARABLE TASK TRAIN/NO TRAIN

Table 3-8 Data Summary Worksheets DIF Algorithm(Continued)

SYSTEM ____________

PERCENT

(a) TASK TITLE	(b) OVERTRAIN	(c) TRAIN	(d) NO TRAINING	(e) SUMMARY MEASURE OVERTRAIN = 3 TRAIN = 2 NO TRAIN = 1

Table 3-8 Data Summary Worksheets (Continued)

(a) TASK TITLE	(b) PERCENT PERFORMING	(c) TASK DELAY TOLERANCE 1=low, 7=high	(d) CONSEQUENCE OF INADEQUATE PERFORMANCE (1=low,7=high)	(e) TASK LEARNING DIFFICULTY 1=low,7=high

Table 3-8. Data Summary Worksheets (8FAC).

TASK TITLE	PERCENT PERFORMING (a)	PERCENT TIME SPENT PERFORMING (b)	CONSEQUENCE OF INADEQUATE PERFORMANCE (1-LOW, 7-HIGH) (c)	TASK DELAY TOLERANCE (1-LOW, 7-HIGH) (d)	FREQUENCY OF PERFORMANCE (1-LOW, 7-HIGH) (e)	TASK LEARNING DIFFICULTY (1-LOW, 7-HIGH) (f)	PROBABILITY OF DEFICIENT PERFOR[MANCE] (1-LOW, 7-HIGH) (g)	IMMEDIACY OF PERFORM[ANCE] (1-LOW, 7-HIGH) (h)

(3) Using objective indices of criticality of training such as individual task factor criteria or task factor criteria algorithms (See Table 3-3).

(4) Using some combination of the above methods.

3.1.3.3 Select Tasks for Training

The criterion/cutoff scores determined in procedure 3.1.3.2 are applied in this procedure to produce a tentative list of tasks selected for training. The worksheet presented in Table 3-9 can be used to assist in this process.

3.1.4 Review Current Task Selection

During this procedure, tentative task selections for training are reviewed, revised if necessary, and finalized. An overview of this procedure is presented in Figure 3-9.

3.1.4.1 Review Tentative Task Selection

The purpose of this step is to review the tentative task selection accomplished in procedure 3.1.3.3. If the tentative task selection is adequate, the user is finished. If the number of tasks selected for training either exceeds or falls short of the planned training load, adjustments will need to be made to the task selection criterion/cutoff scores.

3.1.4.2 Revise Criterion/Cutoff Scores

In this step, revised criterion/cutoff scores are developed so that the task selection list will match available training resources.

Table 3-9. Worksheet for Selecting Tasks for Training (TSEL).

System ______________________

(a) Task Title	(b) Summary Score	(c) Cutoff Score	(d) Train	(e) No Train	(f) Comments

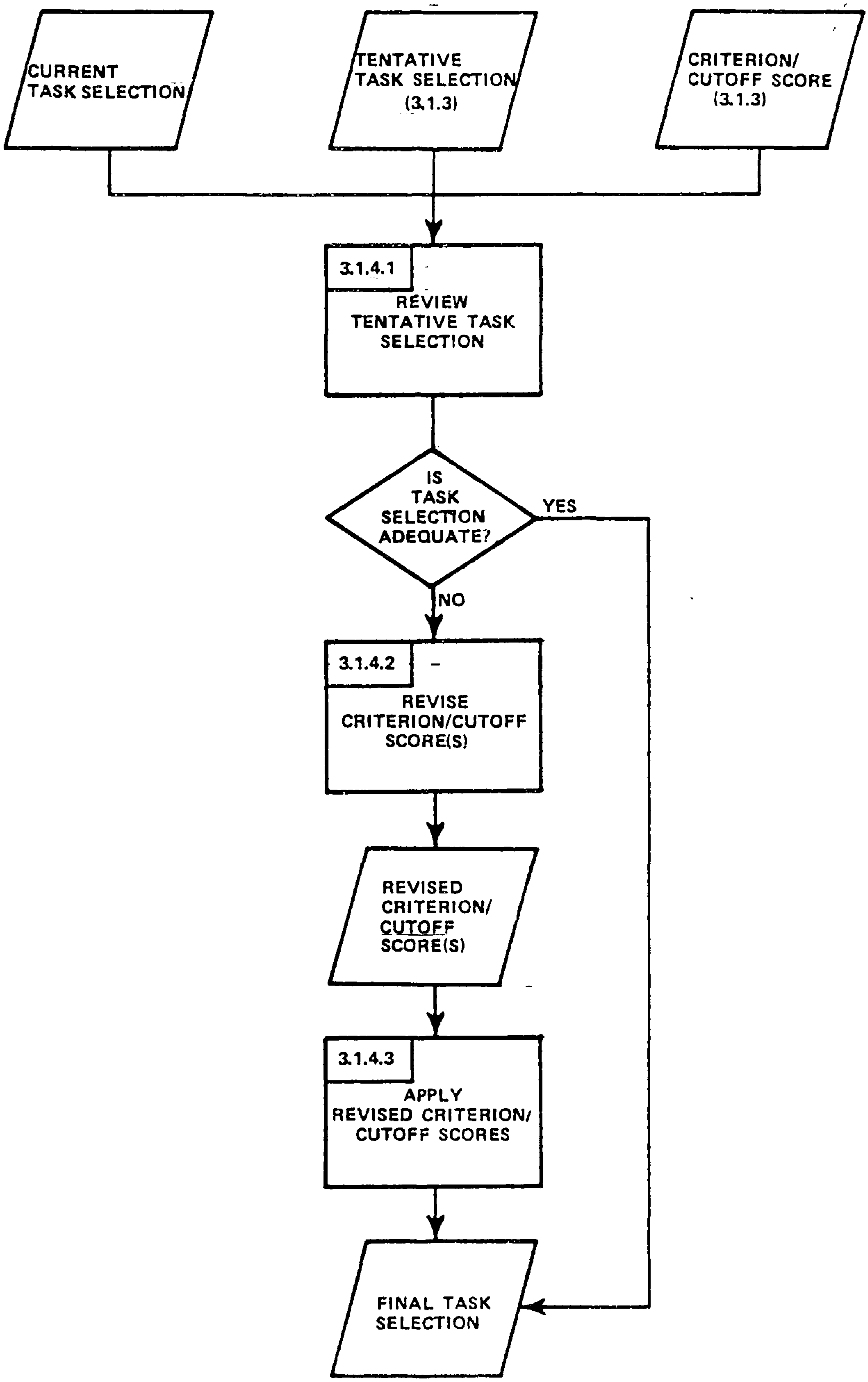

Figure 3-9 Review Current Task Selection (3.1.4)

3.1.4.3 Apply Revised Criterion/Cutoff Scores

Revised criterion/cutoff scores are applied in this step to select tasks for training. The steps described in procedure 3.1.3.3 are repeated and a new list of tasks selected for training is developed.

3.1.5 Document Data

The train-no train decision should be documented in the SDT after tasks have been assigned to training settings in Procedure 3.2.

3.2 ASSIGN TASKS TO TRAINING SETTINGS

Once tasks have been selected for training, they should be further analyzed to determine the most appropriate training setting. The key decision is to allocate tasks between formal school settings, (for example, advanced individual training) and unit training settings (for example, supervised on-the-job training). Once this decision is made, assignments within these two general types of settings can be made.

This procedure describes two basic approaches to assigning tasks to training settings. One approach is comparability analysis which bases training setting assignments on assignments made to comparable tasks. The second approach involves selecting criteria for making training setting assignments, collecting data, applying an aggregation algorithm and making training setting assignments based on the aggregated criterion scores. An overview diagram depicting the steps in this procedure is presented in Figure 3-10.

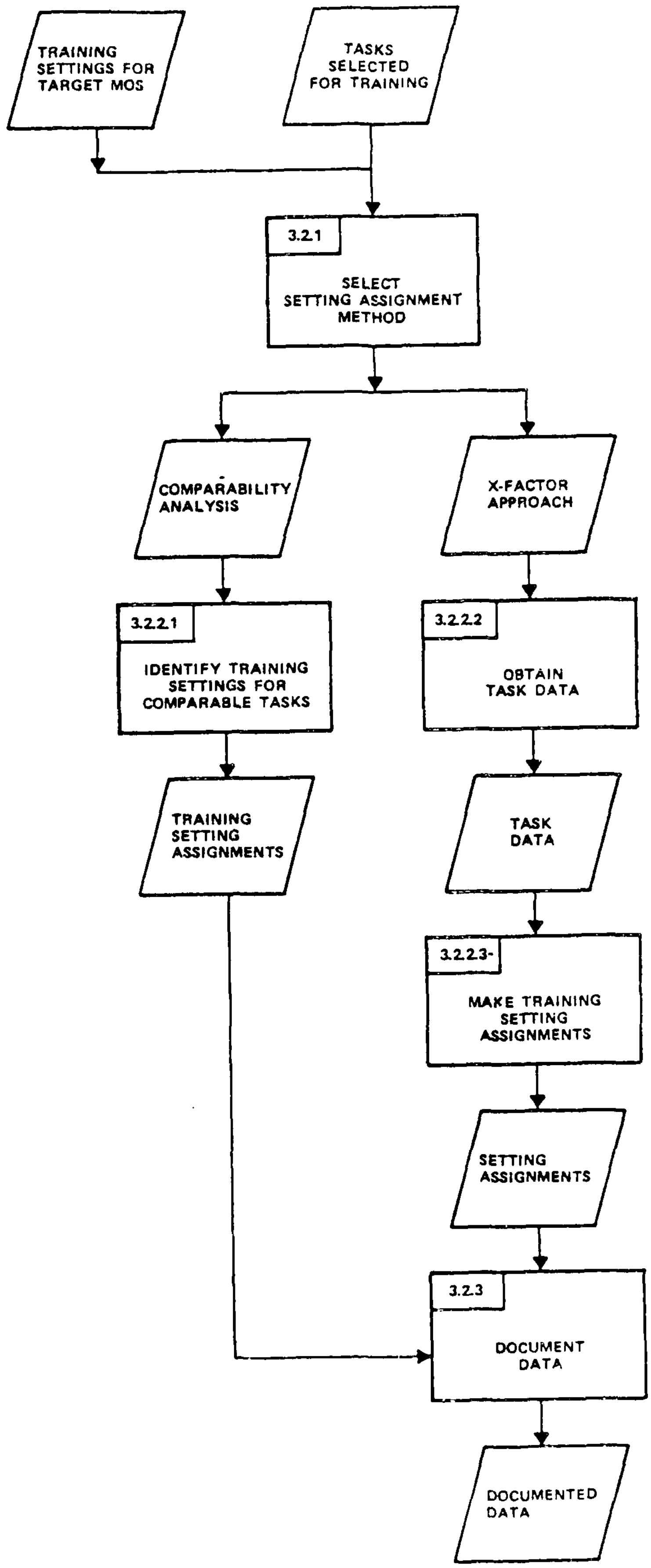

Figure 3-10. Overview of Assignment Tasks to Training Settings (3.2).

3.2.1 Select Setting Assignment Method

There are two basic approaches to assigning tasks to training settings: comparability analysis and the use of a selection algorithm (X-factor method).

- Comparability Analysis

Comparability analysis may be used to provide crude training setting assignments during the early phases of the acquisition process. The first step in the application of comparability analysis is to identify a comparable existing task for each of the tasks in the New System (if comparability analysis was used in Procedure 3.1, the results will support this analysis). A comparable existing task may be defined as a task which (1) is performed on comparable equipment or (2) involves the same type of task action (that is, the action verb for the comparable task matches or is highly similar to the action verb for the New system task).

The second step in comparability analysis is to assign the New system task to the same training setting (institutional training, unit training) assigned to their comparable tasks.

- X-Factor Approach

In this approach, criteria are identified which are relevant to the training setting assignment decision. These criteria will typically include the same criteria used in the procedure for selecting tasks for training. The six factors most likely to be used are task delay tolerance, task learning difficulty, percent time performing, percent performing, time between initial MOS training and required

job performance, and consequences of inadequate performance. Data is collected (If 4-Factor or 8-Factor models were used in Procedure 3.1, much of the required data may already be available) directly by the analyst or from surveys administered by the Army Occupational Survey Program (AOSP) of MILPERCEN. Once information has been collected for each of the X-factors for every task during Procedure 3.1, there will be a large data base to use for assigning tasks to training settings. The user should select the same subset of factors used in Procedure 3.1.

The X-Factor approach is more comprehensive than the comparability analysis approach and has greater data requirements. Therefore, the X-Factor approach and be more appropriate later in the acquisition process when more accurate training setting assignments are required.

3.2.2.1 Identify Training Settings for Comparable Tasks

If the comparability analysis approach is selected, then training settings for comparable tasks are identified (if comparability analysis was employed in Procedure 3.1, this data may already be available). These existing training setting assignments are then simply transferred to the New system tasks. Once the assignments have been made, the user can advance to Procedure 3.2.3 (Document Data).

3.2.2.2 Obtain Task Data

If the user selects the X-Factor approach, data must be collected on the task factors. First, however, the user must select the criteria to be included in the analysis. Two of the more useful criteria for the training assignment decision are:

- Percent performing - The greater the proportion of individuals in an MOS who perform a task on the job, the greater the payoff for training them in an institution. Thus, if a specific duty position accounts for a substantial percentage of the personnel within an MOS, then that duty position is identified to be trained in the institution. For example, for MOS 95B, Military Police, at Skill Level 1, there are several different duty positions, such as military police, desk clerk, radio dispatch clerk, fingerprint clerk, machine-gunner, investigator, prisoner-of-war processing specialist, etc. The majority of these duty positions account for a relatively small percent of the total MOS strength. However, the training assignment decision is easy because the position of military police accounts for approximately 60 percent of the MOS for Skill Level 1.

- Time between training and required job performance - If a task is complex and requires practice to maintain proficiency then tasks which are not performed by soldiers within 6 months after training should be trained in the unit.

- Consequences of Inadequate Performance - This criteria is important insofar as it indicates which tasks may need concentrated or professional instruction that can best be accomplished in an institutional setting.

Data on these or other selected criteria can either be collected in surveys conducted directly by the analyst or

through the Army Occupational Survey Program (AOSP) (more details on procedures for collecting this data are provided in Section 3.1.) These data can be summarized on a worksheet like that shown in Table 3-10. Data entries to this worksheet should consist of mean scores/ratings for each task on each criteria.

As part of the data collection process, the user should also examine the Trainer's Guide for the MOS. This guide will define the specific training settings currently used for the MOS. If a new MOS is involved, training settings for other comparable MOSs should be used (see Section 2.0 for information on identifying comparable MOSs).

3.2.2.3 Make Training Setting Assignments

Training setting assignments must be made in a two step process. First, tasks should be assigned to the either institutional or unit training setting categories. Second, specific settings within each of these general categories must be determined. It should be noted that within the institutional training setting category, there is a close correspondence between specific training settings and skill level. Thus, if you know the skill level of a task and have made the assignment to the institutional training category the assignment of tasks to specific institutional training settings is largely determined. Listed below are the relationships between skill level and institutional training settings.

- o Skill Level 1 - Basic Training, Advanced Individual Training (AIT), or One Station Unit Training (OSUT).

MOS ____________

SYSTEM ____________

(a) TASK TITLE	(b) SELECTED TRAINING SETTING ASSIGNMENT CRITERIA									(c) QUALIFICATION TRAINING ASSIGNMENT	(d) ADDITIONAL TRAINING ASSIGNMENT

Table 3-10 Data Summary Worksheet for Training Setting Assignment (SUMSET)

- Skill Level 2 - AIT, OSUT, or Primary Leadership Course.

- Skill Level 3 - Basic Technical Course.

- Skill Level 4 - Advanced Noncommissioned Officer Course.

- Skill Level 5 - Senior Noncommissioned Officer Course.

Some of the specific training typically included under the unit training category are Supervised On-the-Job Training (SOJT), Self-Study, and Scheduled Training (SCD). These settings do not vary with skill level.

Training may be prescribed for a task in both institutional and unit settings. In these cases, a distinction is made between initial training to proficiency (called qualification training) and subsequent refresher training (called additional training). This procedure is primarily concerned with the identification of settings of initial training assignments since most additional training takes place in units.

The method employed to make initial setting assignments is presented in Figure 3-11. Note that this method is very similar to the method used to select tasks for training.

3.2.2.3.1 Select and Apply Aggregation Method

In this procedure, data contained in Table 3-10 will be aggregated using one of the methods depicted in Table 3-

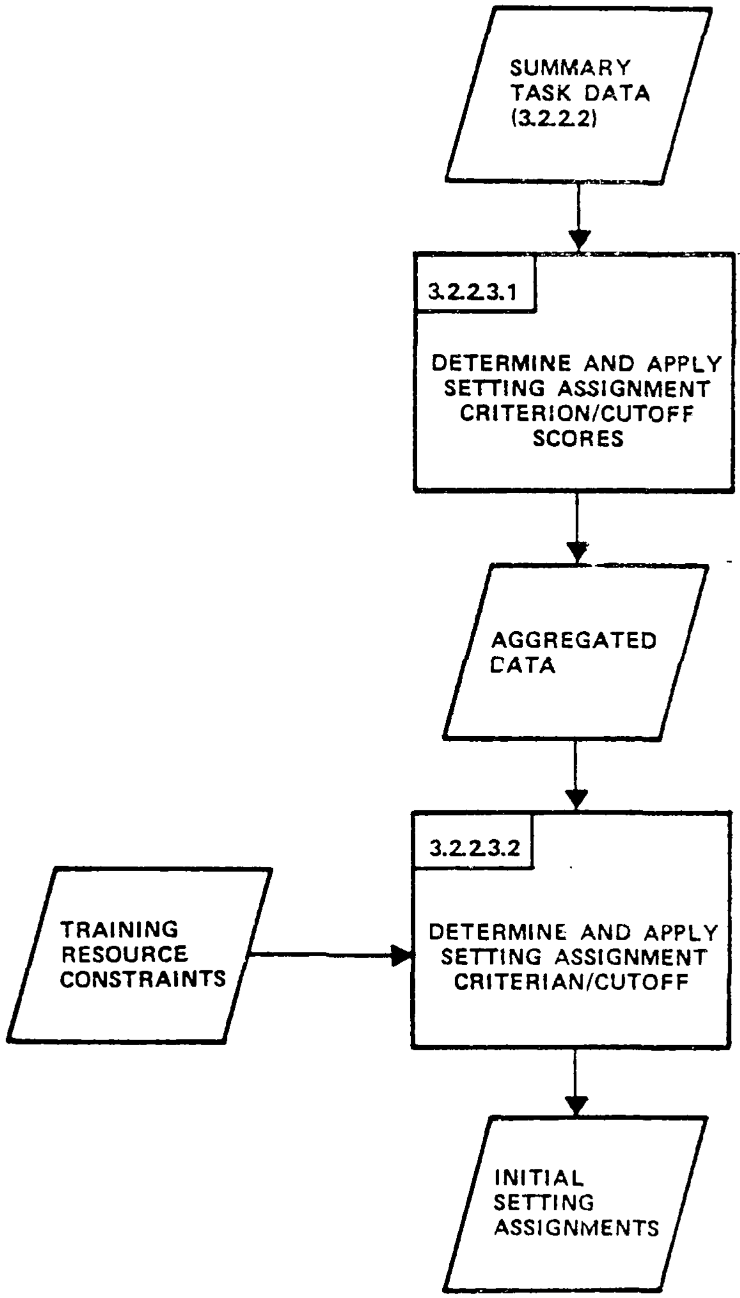

Figure 3-11 Overview of Make Setting Assignments (3.2.2.3)

11. This will result in a summary score/rating for each task. More details in applying these aggregation methods are provided in Procedure 3.1.

3.2.2.3.2 Determine and Apply Setting Assignment Criterion/ Cutoff Scores

Criterion/cutoff scores are identified in this procedure that will be used to assign tasks to training settings. These criterion/cutoff scores must take into consideration any constraints on training resources (e.g., time available in AIT for training, availability of equipment at an institution). The criterion/cutoff scores can be determined by:

- o Using the number of tasks currently trained in a setting for a similar system. After determining the number of tasks trained in a setting on the similar system, a cutoff point on the summary measure is set which selects the same number of tasks.

- o Examining available training resources to determine the available training time in each setting. A cutoff score can then be set which will produce the appropriate number of tasks.

- o Using objective indices of appropriateness of a setting for a particular task such as individual task factor criteria or task factor criteria algorithms (See Table 3-11).

- o Using some combination of the above methods.

Once tasks have been assigned to the institutional training category, they should be assigned to specific settings within each category. As indicated in Section 3.2.2.3, this is largely determined by the skill level of the task. Additional guidance can be provided by examining the assignments made to similar tasks.

The resulting task assignments will determine the location of qualification training, but in most instances additional training will be required. For example, if AIT is the setting for qualification training, SOJT would likely to be selected for additional training. This procedure does not specifically address the question of training sites for such additional training since most of this training takes place in the unit.

3.2.3 Document Data

In this procedure, tasks which are selected for training and assigned to training settings are entered into the SDT as shown in Table 3-12.

3.3 IDENTIFY SKILLS AND KNOWLEDGES

OVERVIEW

During this step, skills and knowledges are determined for the BCS and New system tasks which were selected for training in Procedure 3.2.

PROCEDURE

An overview of this procedure is presented in Figure 3-12. A worksheet which can be used to support this procedure is presented in Table 3-13.

Table 3-11. Aggregation Methods for Assigning Tasks to Training Settings

Weighted Z Scores

$$TPI = \sum_{I=1}^{n} W_i Z_{ij}$$

where TPI is the training priority index; W is the weight assigned to the i the task factor; and Z_{ij} is the Z score of the i^{th} task on the j^{th} factor; and N is the number of task factors.

$$\frac{Z_{ij} = X_{ij} - X_j}{SD_j}$$

where X_{ij} is the raw score of the i^{th} task on the j^{th} factor; X_j is the mean of the X_{ij} for the j^{th} factor; and SD_j is the standard deviation of the X_{ij} for the j^{th} factor.

Individual Task Factor Criteria

In this method, cut points are established for individual task factors. Thus, for example, a cutoff point of 6.0 could be established on the factor, consequences of inadequate performance. As a result, any task with task factor scores exceeding 6.0 would be selected for training. Similar criteria could be established for other task factors.

e.g., Select for training if:
$\geq$ 6.0 on Task Factor 1
$\geq$ 5.0 on Task Factor 2
$\geq$ 5.0 on Task Factor 3

Evaluate each task against criteria for each task factor.

Task Factor Criteria Algorithms

A task factor criteria algorithm specifies, for a particular combination of values on task factors, whether a task should be trained. Such algorithms are not really used to aggregate task factor scores as much as to lead the analyst to a solution.

Table 3-12. Guidelines for Entering Data Into SDT (3.2).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
3.2	Training Emphasis Ratings (Task Factors)	Tasks	SUMSET	B	1
3.2	Training Setting Assignments	Tasks	SUMSET	C, D	2

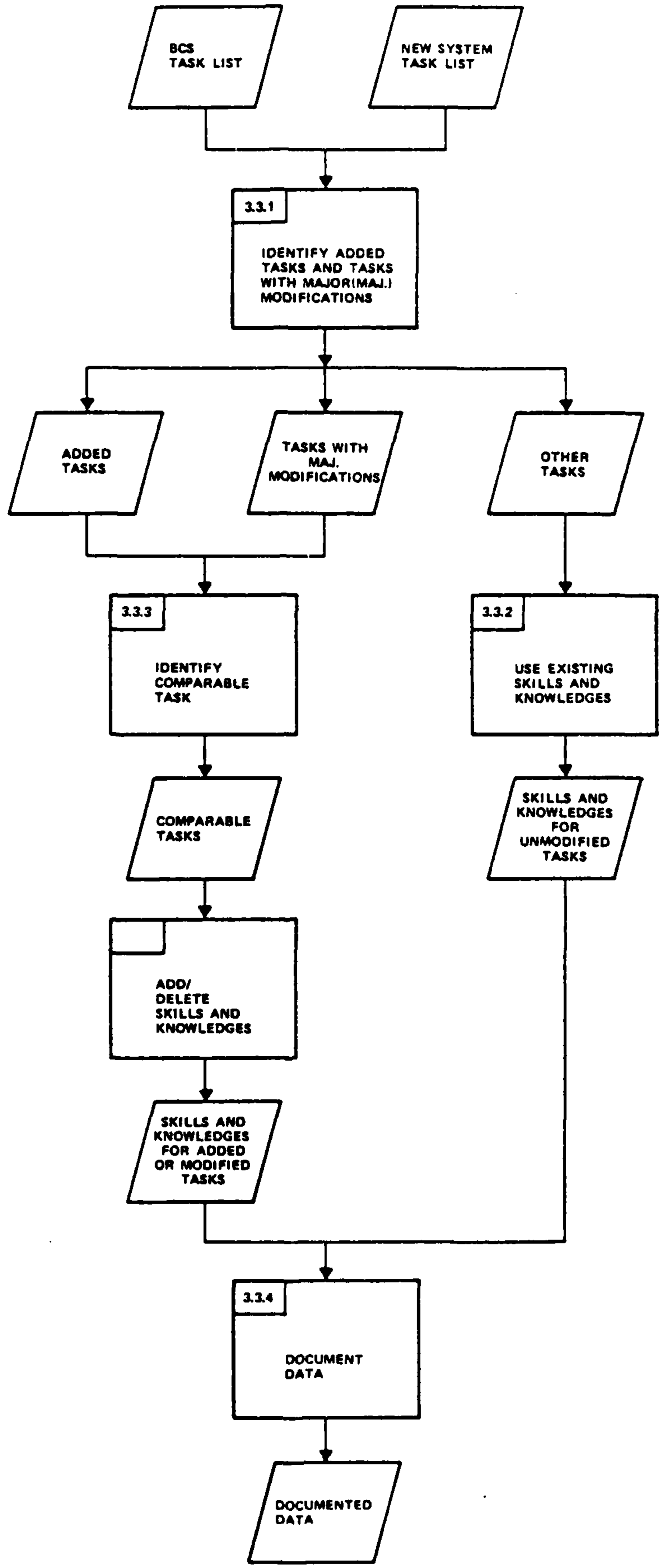

Figure 3-12. Overview Diagram: Identify Skills and Knowledges (3.3).

Table 3-13 Skill and Knowledge Worksheet (Skill)

SYSTEM ______________________ MOS/SKILL LEVEL ______________

(a) TASK: ______________________

(b) COMPARABLE TASK: ________________

COMPARABLE/UNMODIFIED TASK SKILLS		MODIFIED/NEW TASK SKILLS	
(c) SKILL	(d) SOURCE	(e) SKILL	(f) SOURCE

To begin the procedure, you must examine the BCS and New system task list. These tasks must be then categorized into two groups, (1) added or modified tasks and (2) unmodified existing tasks. For unmodified tasks, existing skill and knowledges can be utilized. Table 3-14 lists some of the data sources which can be used to obtain information or skills and knowledges for existing tasks. As skill and knowledge information on existing tasks is obtained, it should be entered into columns (a) and (b) of the Skill and Knowledge (SKILL) Worksheet.

To estimate skills and knowledges for added or modified tasks, comparability analysis techniques must be used. More specifically, a comparable existing task must be identified and information on the skills and knowledges of this task must be collected. Skills and knowledges from tne comparable task must then be added or deleted to reflect the differences between the equipments and functions associated with the comparable task and the added or modified task (Information on equipments and functions should be available from Procedure 1.0)

A comparable existing task may be defined as a task which (1) is performed on comparable equipment (procedures for identifying comparable equipments are listed under Function 1.0) and (2) involves the same type of task action (that is, the action verb for the comparable task matches or is highly similar to the action verb for the New System task).

In addition, if it is possible, the comparable task should be selected from the same occupational specialty (MOS) as the New system task.

Table 3-14. Skill and Knowledge Data Sources

- Soldier Manuals**
- Trainer's Guide**
- Job Book**
- CODAP**
- LSAR*
- ARTEPs**
- Field Manuals**
- Maintenance Manuals**
- Skill Performance Aids**
- Maintenance Allocation Charts*
- Training Development Information System (TDIS)**
- Contractor Supplied Training Programs*
- Program of Instruction (POI)

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* Data source for developing systems

** Data source for existing systems

All skill and knowledge statements should be constructed in accordance with existing ISD guidelines. (See Schulz and Farrell, 1980 and TRADOC Pam 350-30 for a description of these guidelines).

Once the skills and knowledges for the new or modified tasks have been identified, they should be entered into column (e) and (f) of the SKILL worksheet.

Once the SKILL worksheets have been completed, relevant data from these worksheets should be entered into the SDT. Table 3-15 describes the most desirable order for entering data into the SDT. Additional guidance for entering data into the SDT is provided in the SDT User's Guide.

During the later phases of the acquisition process you may want to do a more detailed task analysis and enter some additional data on tasks in the SDT. Some of the types of data typically collected during these types of more detailed task analyses are:

- Task Elements
- Preceding and Succeeding Tasks (in terms of mission performance)
- Tools/Test Equipment
- Failure Modes (maintenance tasks only)
- Initiating Cues
- Terminating Cues
- Learning Objectives
- Performance Measures

- Task Frequency and Duration Measures
- Work Area/Task Area
- Amount of Supervision
- Number of Performing

If necessary, these items can be generated by the same comparability analysis techniques used to estimate skills and knowledges. The sequence for entering this data into the SDT is displayed in Table 3-15.

3.4 DEVELOP TARGET POPULATION DESCRIPTION

OVERVIEW

Target population descriptions must be developed for each job within an MOS for the New system. A job is a set of related duty positions within an MOS (see TRADOC Pam 351-4, Job and Task Analysis Handbook, for a more detailed description of what constitutes a job). The elements of a job-description for a new systems, per TRADOC Pam 351-4, are (a) skill level, (b) occupational specialty, (c) educational level, (d) prerequisite training, prerequisite education, (including reading grade level), (e) performance data (if available), (f) enlistment rates, and (g) overseas tour length.

PROCEDURE

Table 3-15 describes how each element of the target population description can be developed during the early phases of the acquisition process. Skill level and occupational specialty are determined during Procedure 2.0. For the remaining elements of the target population

Table 3-15. Guidelines for Entering Data Into SDT (3.3).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
3.3	Skills and Knowledges	Tasks	SKIL	C, E	1
3.3	Task Elements	Tasks	-	-	2 (optional)
3.3	Tools and Test Equipments	Tasks	-	-	2 (optional)
3.3	Initiating/Terminating Cues	Tasks	-	-	2 (optional)
3.3	Failure Modes	Tasks	-	-	2 (optional)
3.3	Preceding/Succeeding Tasks	Tasks	-	-	2 (optional)
3.3	Learning Objectives	Tasks	-	-	3 (optional)
3.3	Performance Measures	Tasks	-	-	4 (optional)
3.3	Task Frequency Duration	Tasks	-	-	2 (optional)
3.3	Work Area/Task Area	Tasks	-	-	2 (optional)
3.3	Amount of Supervision	Tasks	-	-	2 (optional)
3.3	Number Performing	Tasks	-	-	2 (optional)

Table 3-16. Procedures for Developing Target Population Description Elements

ELEMENT	METHOD FOR DEVELOPING
Skill Level	Obtain from Procedure 2.0
Occupational Specialty	Obtain from Procedure 2.0
Educational Level	Use Data From Existing or Comparable MOS
Prerequisite Training	Use Data From Existing or Comparable MOS
Performance Data	Use Data From Existing or Comparable MOS
Enlistment Rates	Use Data From Existing or Comparable MOS
Overseas Tour Length	Use Data From Existing or Comparable MOS

description, current data for the occupational specialty should be employed. If a new occupational specialty is involved, data from a comparable MOS should be employed.[1] Procedures for identifying comparable MOSs are listed under Procedure 2.0.

A worksheet for documenting the target population description is provided in Table 3-17.

3.5 SEQUENCE TASKS/SKILLS FOR TRAINING

OVERVIEW

During this procedure, the tasks/skills associated with each setting are placed in the sequence in which they must be trained.

PROCEDURE

An overview of the procedure for sequencing tasks for training is provided in Figure 3-13. First the tasks associated with each setting are identified. This information will be available from Procedure 3.2.

Once tasks for each setting have been identified, these tasks must be sorted into groups of "functionally similar"

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1 This procedure only provides gross estimates of the target population description elements that are appropriate for the earliest phases of the acquisition process. More specifically, the procedure does not attempt to adjust the target population elements to account for task modifications or additions within an MOS.

Table 3-17. Target Population Worksheet (POP).

SYSTEM ______________

(a) MOS	(b) SKILL LEVEL	(c) COMP. MOS	(d) EDUCATIONAL LEVEL	(e) PREREQ. TRAINING	(f) PERFORMANCE DATA	(g) ENLISTMENT RATE	(h) TOUR LENGTH
COMPARABLE MOS							

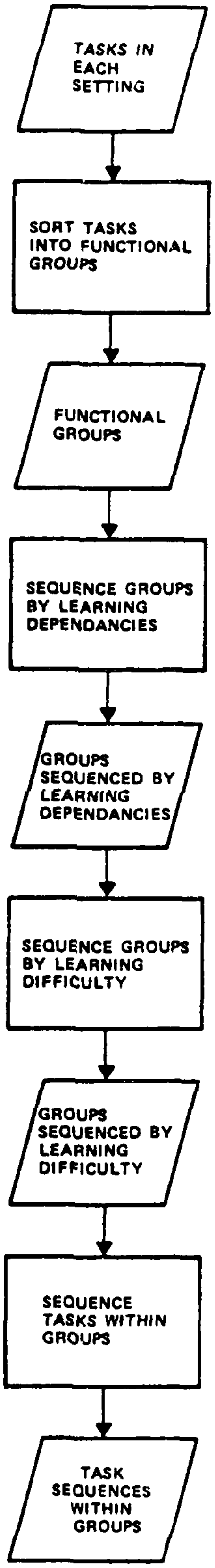

Figure 3-13. Overview Diagram: Sequence Tasks/Skills for Training (3.5).

tasks. There are two criteria for identifying functionally similar groups of tasks.

(1) Action Verb Similarity - Tasks should be sorted into groups which have similar task action verbs.

(2) Equipment Similarity - Tasks should be sorted into groups which involve comparable or similar equipments. Procedures for identifying comparable existing equipments are provided under Procedure 1.0.

Note that the criteria for identifying functionally similar tasks is the same as the criteria for identifying comparable existing tasks, as described in Procedure 3.3.

Once tasks have been sorted into functional groups, the groups must be sequenced to reflect the learning dependency relationships among the groups (that is what groups of tasks represent prerequisite skills and knowledges which must be learned before other groups of tasks). Detailed guidance for identifying these types of learning dependencies is provided in Schulz and Farrell (1980).

Once the groups have been sequenced to reflect learning dependencies, they must be rank-ordered to reflect the estimated learning difficulty of the tasks within the groups (Guidelines for estimating learning difficulty were presented in Procedure 3.1).

After the functional groups have been sequenced, the tasks within each group should be sequenced using the same criteria to sequence the groups (i.e., learning dependency and learning difficulty).

A worksheet which can be used to document the results of this procedure is presented in Table 3-18.

3.6 CONSTRUCT QUASI-PROGRAM OF INSTRUCTIONS

During this procedure, quasi-program of instructions (QPOIs) are developed for individual institutional training courses. The quasi-POI provides a convenient vehicle for summarizing the content of a course/instructional program during the early phases of development. It provides the information needed to determine the resource and cost requirements of a course/program, to estimate its efficiency/effectiveness, and to plan for its development. A worksheet which can be used to support the procedure is provided in Table 3-19. This worksheet summarizes the essential elements of the QPOI. It should be noted that ETES currently contains procedures for developing QPOIs for individual institutional training courses.

ETES does not currently include procedures for developing QPOIs for individual unit training or collective training or for developing outlines for reference material.

PROCEDURE

An overview of the procedure for constructing quasi-POIs for instructional training is provided in Figure 3-14.

There are five steps in the construction of quasi-POIs for individual institutional training courses: (1) identification of courses and course modules; (2) identification of the methods to be used within each course module; (3) identification of the contact hours to be devoted to each

Table 3-18 Task/Skill Sequence Worksheet (SEQ)

MOS ____________________ SYSTEM ____________________

SKILL LEVEL ____________________

(a) TASK/SKILL	(b) FUNCTIONAL GROUP	(c) GROUP DIFFICULTY	(d) GROUP SEQUENCE	(e) TASK/SKILL SEQUENCE

Table 3-19. QPOI Worksheet – Part 1 (QPOI-1).

COURSE NUMBER: ____________ MOS/SYSTEM ____________

COURSE TITLE: ____________

COURSE LENGTH: ____________

COURSE TYPE: ____________

COURSE STATUS: ____________

(a) MODULE	(b) MODULE LENGTH	(c) METHOD-1			(d) METHOD-2			(e) METHOD-3			(f) METHOD-4			(g) METHOD-5		
		METHOD	S/I	LENGTH	METHOD	S/I	LENGTH	METHOD	S/I	LENGTH	METHOD	S/I	LENGTH	METHOD	S/I	LENGTH

Table 3-19 QPOI Worksheet-Part 2 (QPOI-2)

COURSE NUMBER ______________ SYSTEM ______________

COURSE TITLE ______________

COURSE LENGTH ______________

MODULE ______________

(a) TASKS	(b) MEDIA

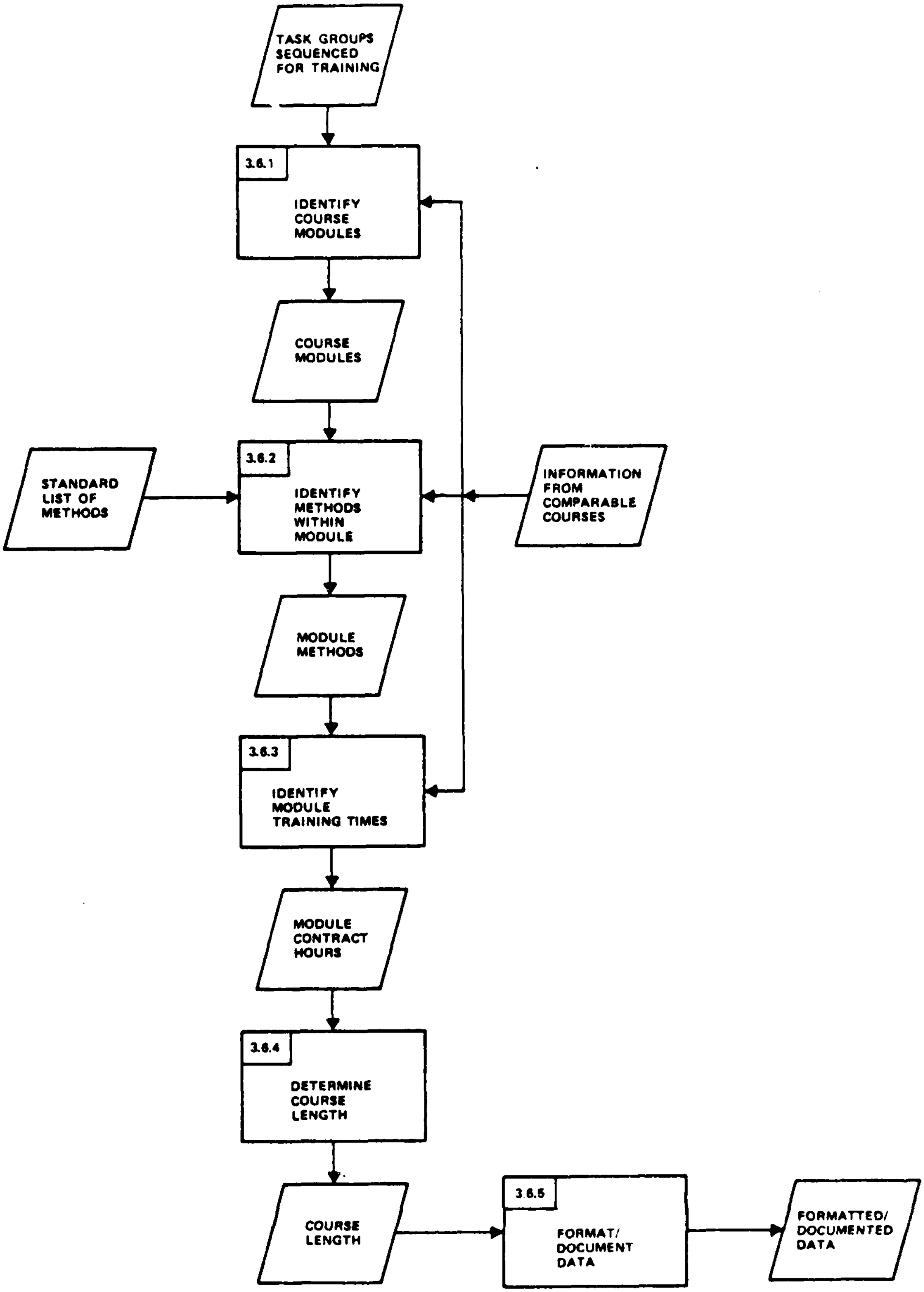

Figure 3-14. Overview Diagram: Construct QUASI–POI (3.6).

method within a module; (4) determination of course length, and (5) documentation and formatting of the QPOI.

More details on each of these steps is provided in the sections which follow.

3.6.1 Identify Courses and Course Modules

The training task sequence relationships which were identified in Procedure 3.5 for all the tasks within a setting are examined and logical break-points in the sequence are identified where tasks may be grouped together to form courses and course modules. Guidance for the construction of courses and modules is provided by the examination of the types of courses currently used in the MOS and/or predecessor system and the modules within these courses which deal with similar tasks. Similar tasks may be identified by examining (e) the task action verb and (b) the equipment on which the task operates. (Procedures for identifying "similar" tasks were identified in Procedure 3.3. Identification of comparable modules can be facilitated by identifying the comparable existing course which most closely matches the task requirements of the new system. (Usually this comparable course is the course is the course from the predecessor system).

Modules may be added to or deleted from the comparable course to reflect the New system task requirements. An example of a worksheet which can be used to document modifications to an existing course is presented in Table 3-20. Data sources for identifying comparable courses are listed in Appendix E.

TABLE 3-20. SAMPLE COURSE MODIFICATION WORKSHEET (CMOD)

SAMPLE COURSE MODIFICATION WORKSHEET

SYSTEM: REFERENCE

COURSE 250-13E10 MOS 13E10

FIGURE 2.9.7
COURSE MODIFICATION
WORKSHEET FORMAT

EXISTING COURSE INFORMATION				MODIFIED COURSE INFORMATION									
COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	S/I RATIO	TASKS	COURSE ANNEXES, FILES, AND OBJECTIVES	HOURS	TYPE INSTRUCTION	S/I RATIO	COURSE ANNEXES, FILES, AND OBJECTIVES USED TO PROJECT ADDED MODULES	HOURS	TYPE INSTRUCTION	S/I RATIO	EQUIP. NUMBER
Note: Annexes A, B, & C are part of the OSUT POI.													
Annex D: Communication/ Electronics Department					Annex D: Communication/ Electronics Department								
CE100C: Radio Sets AN/VRC-46, VRC-46, and AN/GRA-39	3.4 5.0	C PEI	31:1 6:1	113-587-2021/3004 113-622-2003/3005	CE100C: Radio Sets AN/VRC-46, VRC-47, and AN/GRA-39	3.4 5.0	C PEI	31:1 6:1					6809
Subtotal	8.4				Subtotal	8.4							
CC100J: CEOI, Authentication Methods, Encrypt/Decrypt Numbers and Letters and Operations Code	1.7 6.7	C PE3	31:1 20:1	113-473-4001/4002	CC100J: CEOI, Authentication Methods, Encrypt, Decrypt Numbers and Letters and Operations Code	1.7 6.7	C PE3	31:1 20:1					None
Subtotal	8.4				Subtotal	8.4							
CE100O: Intercommunications Set AN/VIC-1	.8 1.7	C PEI	31:1 6:1	113-587-2019	CE100O: Intercommunications Set AN/VIC-1	.8 1.7	C PEI	31:1 6:1					6809
Subtotal	2.5				Subtotal	2.5							
CE100K: Antennas RC-292 and AT 984 A/G	4.2	PEI	6:1	113-596-1003/1009/3001	CE100K: Antennas RC-292 and AT-984 A/G	4.2	PEI	6:1					6809
CE100A: Radio Set AN/GRC-160 and Security Equipment KY-38	1.7 2.5	C PEI	31:1 6:1	--	CE100A: Radio Set AN/GRC-160 and Security Equipment KY-38	1.7 2.5	C PEI	31:1 6:1					None
Subtotal	4.2				Subtotal	4.2							
CC100M: Radiotelephone Procedure	4.2	PE3	20:1	113-571-1005	CC100M: Radiotelephone Procedure	4.2	PE3	20:1					None
CC100N: Low Level Antijamming Procedures	4.2	PEI	6:1	161-306-1001	CC100N: Low Level Anti-jamming Procedures	4.2	PEI	6:1	From: 010-19E(M60A3) 19E BAT				None
				171-13E-1X01	CXXXX1: Night Vision Intensifier AN/VVS-2	.3 .7	C PEI	31:1 6:1	DR114: Operate the AN/VVS-2 on an M60 Series Tank (Less the M48A5 and M60)	.3 .7	C PEI	N/A	1803
					Subtotal	1.0			Subtotal	1.0 1.0			
CC100I: Examination and Critique	1.7 4.2	E3 EI	31:1 6:1		CC100I: Examiantion and Critique	1.7 4.2	EI EI	31:1 6:1					
Subtotal	5.9				Subtotal	5.9							

As part of the module identification process, the user must identify non-academic modules. Non-academic modules are modules which are not associated with task requirements. For example, testing modules are usually included at the end of each major section of a course. In addition, modules are often added to a course for non-academic subjects such as commandant's/commander's time, in-processing/out-processing, chaplain's orientation, etc. Again, these types of modules can be identified by examining the modules included in a comparable course.

After the modules have been identified, each module is assigned a name which summarizes its content.

3.6.2 Identify Methods Within Modules

Table 3-21 displays the instructional methods which are used in institutional training. The instructional methods which must be used to train each module are identified by examining the instructional methods used in modules from existing courses dealing with similar tasks. Methods must be added or deleted to reflect the differences between the tasks included in the module from the comparable course.

3.6.3 Identify Module Training Times

Module training times are identified in a two-step process. In the first step, the total training time for a module is determined. This is accomplished by modifying the training time from the comparable existing module to reflect the differences in task requirements between the proposed and existing module.

TABLE 3-21 INSTRUCTIONAL METHODS

AT	Audio Tape
C	Conference/Lecture
CAI	Computer Assisted Instruction
CS	Case Study
D	Demonstration
DF	Dual Flight Hours (only aviator courses) (do not include in ICH computations)
E1	Hardware Performance Examination
E2	Nonhardware Performance Examination
E3	Nonhardware Performance Examination
EL	Elective (in-house only, except for CGSC)
F	Film
GS	Guest Speaker
IS	Independent Study
NC1	Non-contact Instruction with an Instructor Available in Classroom
NC2	Non-contact Instruction without an Instructor Available
PE1	Hardware Oriented (hands-on) Practical Application
PE2	Nonhardware Oriented (non-classroom) Practical Application
PE3	Classroom Practical Application
PI	Programmed Instruction (using programmed text)
PM	Printed Materials
QC	Besseler Cue See
S	Seminar
SF	Solo Flight Hours (only aviator courses) (do not include in ICH computations)
SI	Simulation Instruction
SP	Self-Paced Instruction
ST	Slide Tape
TV	Television
WC1	Instructor Led Work Group
WC2	Student Led Work Group

Sources: DA Pam 570-558 Staffing Guide for U.S. Army Service Schools and TRADOC Cir 351-12 Format for Programs of Instruction

In the second step, training times for each method within a module are determined. This is accomplished by modifying the training times for the methods from the comparable existing module to reflect task differences between the proposed and existing module.

3.6.4 Determine Course Length

Total course length is determined by summing the module training times.

3.6.5 Document Data

Information developed in the previous step is placed in the QPOI format listed in the QPOI Worksheet. The QPOI format is divided into two general parts. The first part provides summary information on modules within each course. The second part provides more detailed information on each module.

After the QPOI worksheets have been completed, relevant data from these worksheets should be entered into the SDT. Table 3-22 displays the most desirable index for entering data into the SDT. Additional guidance for entering data into the SDT is provided in the SDT User's Guide.

3.7 ASSIGN TASKS TO MEDIA

Procedures for assigning tasks to media are described in the <u>User's Guide: Media Selection Program</u>. This program is an automated aid for (1) assigning tasks to media, and (2) determining the efficiency and effectiveness of media-task combinations. Relevant data from the Media Selection

Table 3-22. Guidelines for Entering Data Into SDT (3.6).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
3.6	Course Number and Title	Course	QPOI-1	Top of Worksheet	1
3.6	Course Length	Course	QPOI-1	Top of Worksheet	1
3.6	Course Type	Course	QPOI-1	Top of Worksheet	1
3.6	Course Status	Course	QPOI-1	Top of Worksheet	1
3.6	Comparable Course Number and Title	Course	CMOD	Top of Worksheet	2
3.6	Module Title	Course	QPOI-1	A	4
3.6	Module Length	Course	QPOI-1	B	4
3.6	Method Titles Contact Hours	Course	QPOI-1	C thru G	5
3.6	Tasks Associated with Each Module	Course	QPOI-2	A	3

program must be entered into the SDT. Table 3-23 displays the most desirable order for entering data into the SDT. Additional guidance for entering data into the SDT is provided in the SDT User's Guide.

3.8 CONSTRUCT TRAINING PATHS

OVERVIEW

During this procedure, training paths are constructed for each of the MOSs associated with the BCS and New system. The training paths provide a convenient framework for describing the training courses required to train each MOS. The training paths represent the possible flow of individuals as they progress along the career path in their MOS.

PROCEDURE

An overview of the procedure for constructing training paths is provided in Figure 3-15. The first step in this procedure is to examine the non-system related courses in each MOS which were identified as part of the target population identification function (Procedure 3.4). The courses within each MOS are then sorted by skill level. When this is complete, the courses are sequenced to reflect task and skill learning dependencies (what must be learned before what) within skill level. Training paths are then developed to represent the course sequences required for each MOS. An example of training path is provided in Figure 3-16.

A worksheet which can be used to support the development of training paths is provided in Table 3-24. Table 3-25 displays the training path data elements which must be entered into the SDT.

Table 3-23. Guidelines for Entering Data Into SDT (3.7).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
3.7	Training Emphasis Ratings	Tasks	PSYCRIT	D	1
3.7	Stimuli, Responses, Feedback	Tasks	PSYCRIT	A thru C	1
3.7	Media	Media	MSEC	B, C	2
3.7	Media by Courses	Course	MSEC	B, C	2
3.7	Media				

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Figure 3-16. Example of Training Path for Institutional Courses.

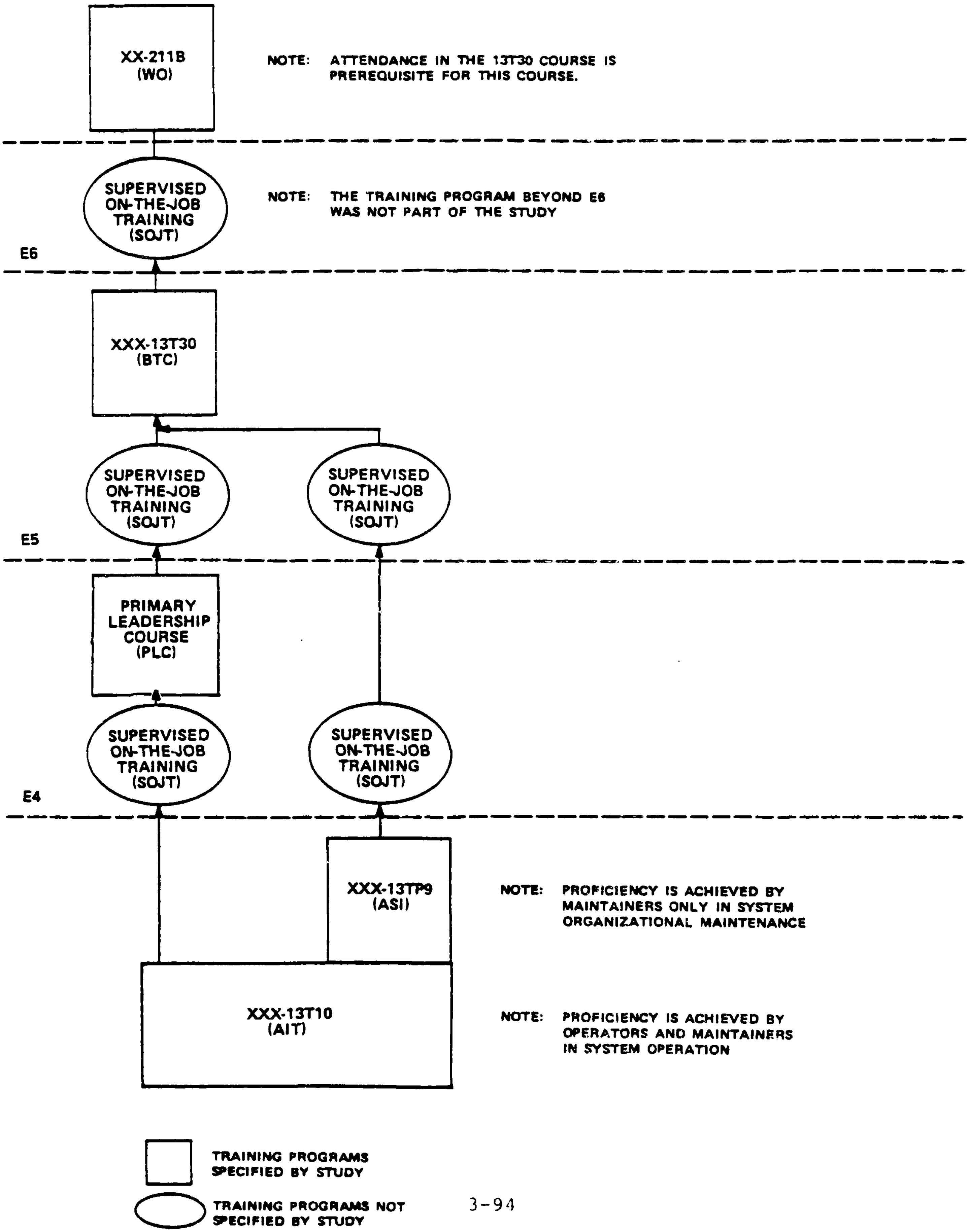

Table 3-24. Training Path Worksheets (PATH).

Course Number____________________ System ____________________

Course Title____________________

(a) Prerequisite Courses	(b) Follow-on Courses

Table 3-25. Guidelines for Entering Data Into SDT (3.8).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
3.8	Prerequisite Courses	Courses	Path	A	1
3.8	Follow-On Courses	Courses	Path	B	1

SECTION 4.0 - ESTIMATE TRAINING RESOURCES

OVERVIEW

During this procedure, training resource requirments are determined for the Predecessor, Baseline Comparison (BCS), and New systems.

PROCEDURE

This procedure is composed of six lower level procedures (See Figure 4-1). During the first procedure, an operating and support plan is developed for each modified or additional course. In the second procedure, the number of students who must be trained in each course is determined. In the third procedure, the number of instructors required in each course is determined. In the fourth procedure, training facilities requirements are determined. In the fifth procedure, training device and training equipment requirements are determined. In the sixth procedure, requirements for other types of training resources are determined. Both phased and steady-state resource requirements are determined during this procedure.

Phased resource requirements are the specific resources that are required while a weapon system is being phased into or out of the inventory (the latter case is generally not relevant during systems development). Phased resource requirements are displayed by calendar year. In order to determine these phased resource requirements, information on the number of weapons systems introduced to the field in each calendar year must be obtained or estimated.

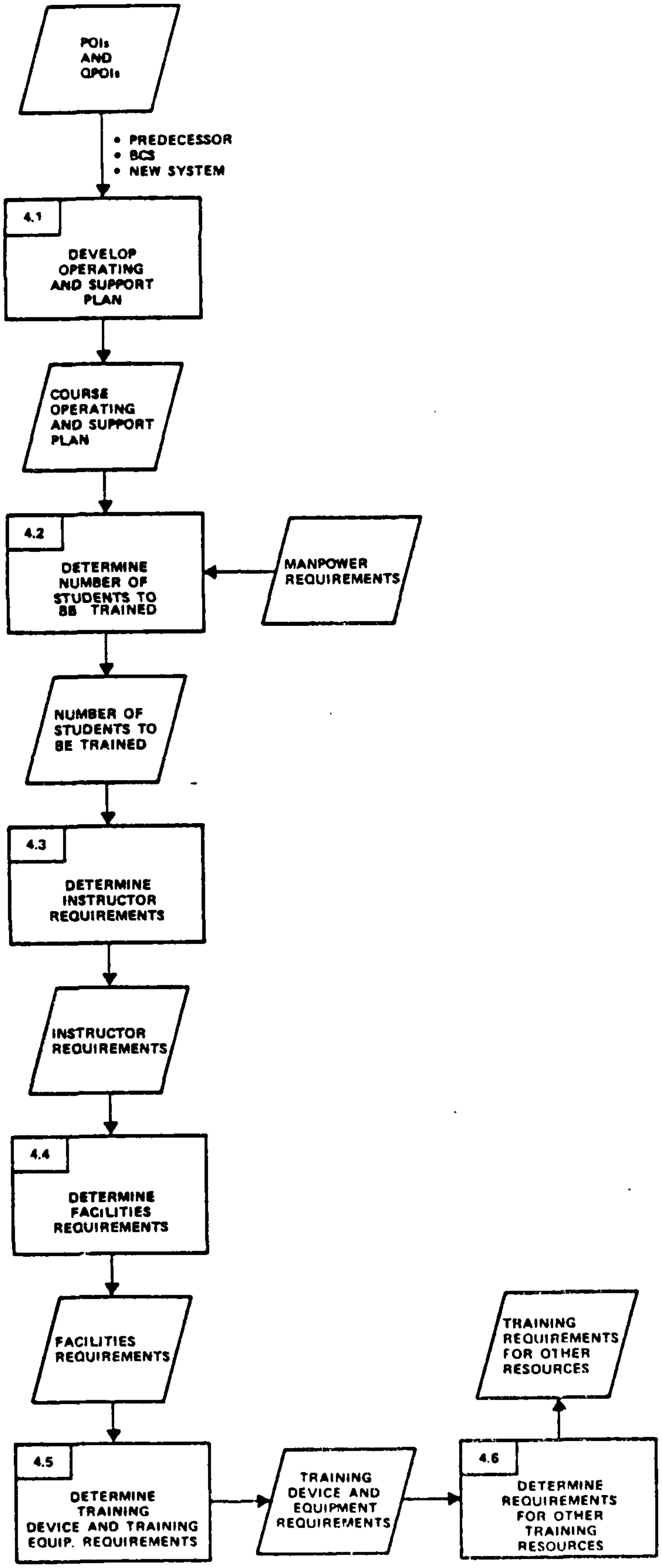

Figure 4-1. Overview Diagram: Determine Course Operating and Support Plan.

Steady-state resource requirements are the estimated average yearly resource requirements that are needed to maintain the weapon system in the field once it has been completely fielded. To estimate steady-state resource requirements, all that is required is an estimate of the total number of systems that will be in the field once system installation has been completed. Steady-state requirements are also presented in yearly units. Because they require less information to calculate, only steady-state requirements are generally calculated during the very earliest phases of the acquisition process.

4.1 DEVELOP COURSE OPERATING AND SUPPORT PLAN

OVERVIEW

During this procedure, an operating and support plan is developed for each new or modified course in the BCS and New systems. The operating and support plan specifies (a) course locations, (b) course frequency, and (c) usage rates for training recruits.

PROCEDURE

This procedure consists of the following three steps: (1) determine course location, (2) determine course frequency, and (3) determine usage rates. Worksheets which can be used to support this procedure are provided in Figures 4-2 and 4-3.

4.1.1 Determine Course Location

An overview of the process for identifying course locations is provided in Figure 4-4. MOS and setting are the primary factors for determining course location. Since these

Course Number ____________ System ____________ Maximum Class Size ________

Course ____________ Attrition Rate ____________

	(b) Steady State		(c) FY ____		(d) FY ____		(e) FY ____		(f) FY ____		(g) FY ____	
	Starts	Sessions	Starts	Sessions	Starts	Sessions	Starts	Sessions	Starts	Sessions	Starts	Sessions
(a) Locations												
____												
____												
____												
____												
____												
____												
TOTAL												
	(i)		(j)		(k)		(l)		(m)		(n)	
Comparable Course ____												
(h) Locations												
____												
____												
____												
____												
____												
____												
TOTAL												

Figure 4-2. Operating and Support Plan Worksheet (OPS).

Course Number____________________ System____________________

Course Title____________________

(a) Media	(b) Usage Rate	Comparable Media		
		(c) Media	(d) Usage Rate	(e) Course

Figure 4-3. Media Usage Rate Worksheet (MUS).

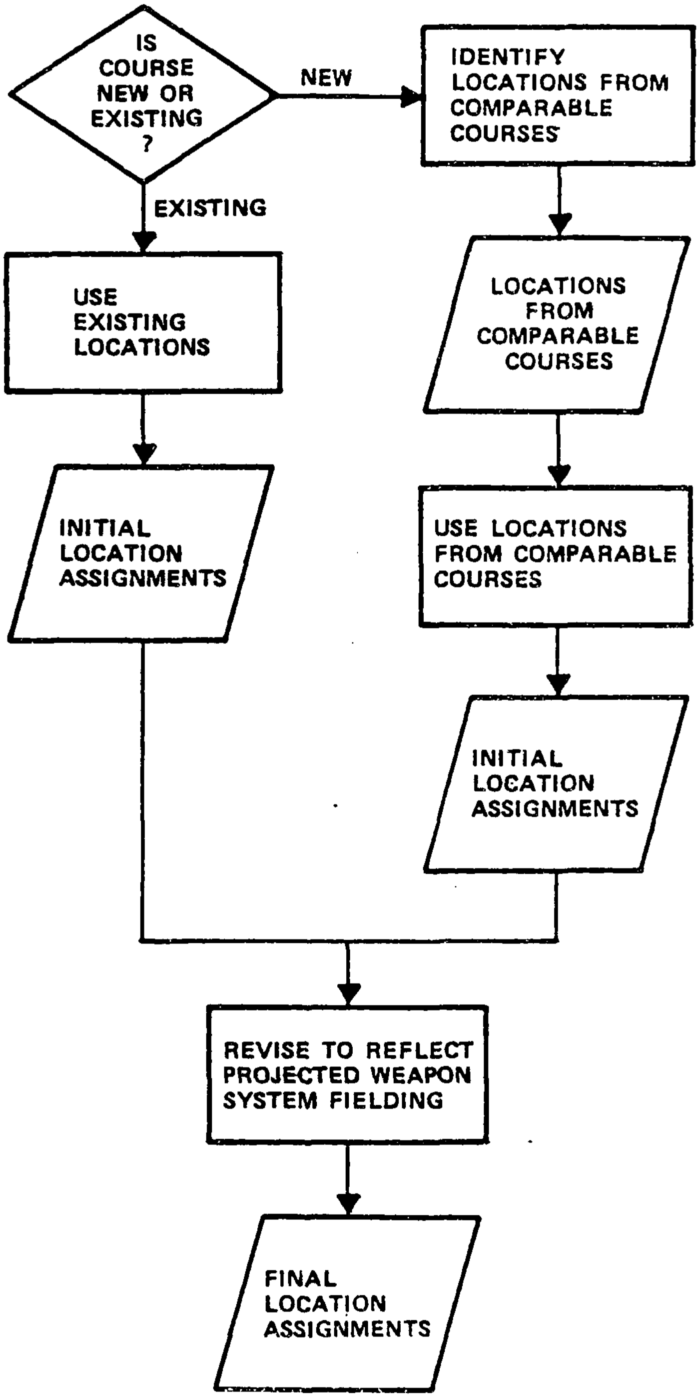

Figure 4-4 Overview of Procedure for Determining Course Locations

information items are identified as part of the QPOI construction process (Procedure 3.6), identification of course locations is relatively straightforward. Additional guidance for course location identification can be provided by examining (a) the course locations used in comparable existing courses and (b) the projected locations where the weapon system will be fielded.

4.1.2 Determine Course Frequency

Course frequency (i.e., the number of starts and sessions per site) is determined by applying the algorithm listed in Table 4-1. To estimate course frequency, you must determine the number of students to be trained (Procedure 4.2). The algorithm listed in Table 4-1 must be applied for each location and year in which the course will be given.

4.1.3 Determine Usage Rates

Usage rates are determined for instructors and training media. The usage rate for instructors is called the student/instructor ratio. The usage rate for media is called the student/media ratio.

Student/instructor ratios are determined for each instructional method used in a course. Table 4-2 displays the student/instructor ratios that are provided for each type of instructional method in DA Pam 570-558 and TRADOC Cir 351-12.

Student/media rates are determined by identifying the rates that were used for similar types of media in comparable courses. This information may be obtained by examining the

TABLE 4-1. ALGORITHM FOR DETERMINING NUMBER OF COURSE STARTS AND SESSIONS PER SITE.

1. Establish number of courses required per site

$$\left(\frac{STUDIN}{NSITE}\right) \div NMAX = NCOURSE$$

STUDIN	= Student Input Requirements
NSITE	= Number of Training Sites
NMAX	= Maximum Student-Instructor Ratio for Course
NCOURSE	= Number of Courses Required Per Site

2. Determine maximum number of starts per year (CMAX)

$$\frac{50}{CLENGTH} = CMAX$$

CLENGTH	= Course Length in weeks
CMAX	= Maximum Number of Course Starts per year (NCON)

3. Select the smaller of NCOURSE or CMAX as the number of course starts (NCON) required per site.

4. Determine maximum number of sessions needed per start (NSES)

If NCOURSE CMAX, NSES = 1

If NCOURSE CMAX, $\frac{NCOURSE}{MAX}$ = NSES

Round NSES up to next highest unit.

TABLE 4-2. METHODS OF INSTRUCTION AND ASSOCIATED STUDENT/INSTRUCTOR RATIOS

AT	Audio Tape	20:1
C	Conference/Lecture	1 per class
CAI	Computer Assisted Instruction	20:1
CS	Case Study	20:1
D	Demonstration	20:1
DF	Dual Flight Hours (Only Aviator Courses)	-
E1	Hardware Performance Examination	6:1
E2	Nonhardware Performance Examination	6:1
E3	Nonhardware Performance Examination	1 per class
EL	Elective (In-House Only, Except for CGSC)	1 per class
F	Film	1 per class
GS	Guest Speaker	1 per class
IS	Independent Study	Local Appraisal
NC1	Non-contact Instruction with an Instructor Available in Classroom	-
NC2	Non-contract Instruction without an Instructor Available	-
PE1	Hardware Oriented (Hands-On) Practical Application	6:1
PE2	Hardware Oriented (Non-Classroom) Practical Application	6:1
PE3	Classroom Practical Application	20:1
PI	Programmed Instruction (Using Programmed Text)	20:1
PM	Printed Materials	20:1
QC	Besseler Cue See	20:1
S	Seminar	20:1
SF	Solo Flight Hours (Only Aviator Courses)	-
SI	Simulation Instruction	Local Appraisal
SP	Self-Paced Instruction	20:1
ST	Slide Tape	20:1
TV	Television	1 per class
WC1	Instructor Led Work Group	Local Appraisal
WC2	Student Led Work Group	Local Appraisal

Sources: DA PAM 570-558
Staffing Guide for U.S. Army Service Schools
TRADOC Cir 351-12
Format for Programs of Instruction

POIs and other associated course documentation from the comparable course. Student/media rates should not exceed the student/instructor ratio for the instructional methods with which they are associated.

4.1.4 Document Data

As course frequency and location information is developed, it should be documented in the operating and support plan worksheets (see Figure 4-2). Media usage rates should be documented in the Media Usage Rate Worksheet (see Figure 4-3). Student/instructor usage rates should be documented in the QPOI Part I worksheet which is listed in Procedure 3.6.

After the worksheets have been completed, relevant data from these worksheets should be entered into the SDT. Table 4-3 describes the most desirable order for entering data into the SDT. Additonal guidance for entering data into the SDT is provided in the SDT User's Guide.

4.2 DETERMINE NUMBER OF STUDENTS TO BE TRAINED

OVERVIEW

During this procedure, the number of students to be trained in the steady-state and phased situations is determined.

PROCEDURE

An algorithm for determining the number of students to be trained in the steady-state condition is provided in Table 4-4. A worksheet which can be used in support of this algorithm is provided in Table 4-5. A worksheet which can be used to calculate the number of students to be trained in the phased condition is presented in Table 4-6. A worksheet

Table 4-3. Guidelines for Entering Data Into SDT (4.1).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
4.1	Course Locations	Course	OPSP	A	1
4.1	Course Frequency	Course	OPSP	B thru G	2
4.1	Student/Instructor Ratios	Course	QPOI-1	C thru G	3
4.1	Media Usage Rate	Media	MUS	B	4

Table 4-4. Algorithm for Determining Steady-State Training Input Requirements

1. Inflate the given manpower requirements by the TTHS rates:

   $M_n = MR_n \times (1 + T_n)$

   where M_n = Adjusted manpower requirements for paygrade n
   MR_n = Manpower requirements for paygrade n
   T_n = Trainee, Transient, Holdee, and Student rates.

2. Calculate levels of X_n which satisfy the following equations for all n:

   $X_n \times (A_n + U_n) = X_{n-1} \times U_{n-1}$, and $X_n = M_n + O_n$

   where X_n = Personnel requirements for paygrade n
   A_n = Yearly attrition rate for paygrade n
   U_n = Yearly upgrade rate for paygrade n
   O_n = Overhead rate for paygrade n.

3. Calculate the number of personnel to be trained per year:

   $TR_n = X_n \times (A_n + U_n)$

   where TR_n = Yearly replacement personnel to be trained for paygrade n.

Table 4-5. Number of Students-Steady State Worksheet (NSSS).

Course Number____________________

Course Title____________________

(a) Location	(b) Manpower Requirements	(c) TN Rate	(d) Adjusted Manpower Requirements	(e) Att. Rate	(f) Upgrade Rate	(g) Personnel Requirements	(h) No. To Be Trained
TOTAL							

Table 4-6. Worksheet for Phased Course Input Requirements

BLOCK ONE

(1) FISCAL YEAR	(2) TOTAL UNADJ* TRAINED PERS REQ'D	(3) TTHS ADJ TRAINED PERS REQ'D

* CUMULATIVE

BLOCK TWO

(1) FISCAL YEAR	(2) STARTING INVENTORY	(3) LOSSES

(1) FISCAL YEAR	(2) TTHS ADJ TRAINED PERS (TTHSA)	(3) STARTING INVENTORY (SI)	(4) TRAINING (+/-) GROWTH (TG) (TTHSA) - (SI)	(5) LOSSES (L)	(6) COURSE OUTPUT REQUIREMENTS (CO) (TG) + (L)	(7) COURSE ATTRITION (CA)	(8) ADJUSTED COURSE INPUT REQ (ACI) (CO) + (CA)	(9) BACKOUT (BO) (+)	(9) BACKOUT (BO) (-)	(10) FINAL ADJUSTED ANNUAL TRAINING INPUT REQ (ACI) + (BO)

BLOCK THREE

TABLE 4-6. WORKSHEET FOR PHASED COURSE INPUT REQUIREMENTS (cont'd)

INSTRUCTIONS FOR COMPUTING ANNUAL TRAINING INPUT REQUIREMENTS

This guide provides the procedural steps to be used in computing the final adjusted annual training input requirements to a single course of instruction. The development of training input requirements involves the application of adjustments to the number of personnel required to be trained in order to compensate for losses through rating and school attrition and to accomodate Transient, Trainee, Holdee, and Student (TTHS) requirements.

PROCEDURAL STEPS

STEP 1. BLOCK ONE, COLUMN (1)

Enter the fiscal years of the planning period.

STEP 2. BLOCK ONE, COLUMN (2)

Enter the cumulative number of trained personnel required.

STEP 3. BLOCK ONE, COLUMN (3)

Enter the product of the Total Unadjusted Trained Personnel required in Column(2)and the TTHS factor to determine the number of TTHS Adjusted Trained Personnel Required.

Transient, Trainee, Holdee, and Student (TTHS) Factor - a factor calculated from historical data used to inflate the cumulative total trained personnel to account for personnel in a transient, trainee, holdee, or student status who are therefore unavailable to occupy a duty position. A factor of 1.09 should be used in the absence of a historical figure.

TABLE 4-6. Worksheet for Phased Course Input Requirements (cont'd)

STEP 4. BLOCK TWO, COLUMN (1)

Enter the fiscal years affected from Block One, Column (1).

STEP 5. BLOCK TWO, COLUMN (2)

Enter the TTHS Adjusted Trained Personnel Required from Block One, Column (3) as the Starting Inventory for the following fiscal year. These data are entered one year later since the number trained in one year represents the starting inventory for the next year.

STEP 6. BLOCK TWO, COLUMN (3)

Enter the product of the starting inventory in Column (2) and the Loss Factor to determine the number of losses per year.

Loss Factor - a factor calculated from historical data used to inflate the number of personnel required to be trained to account for losses due to non-reenlistment and other attrition from the service. Loss is a function of several different loss factors; a factor of 0.15 should be used in the absence of an empirical figure.

STEP 7. BLOCK THREE, COLUMN (1)

Enter the fiscal years affected from Block One, Column (1).

STEP 8. BLOCK THREE, COLUMN (2)

Enter the TTHS Adjusted Trained Personnel Required from Block One, Column (3).

STEP 9. BLOCK THREE, COLUMN (3)

Enter the Starting Inventory from Block Two, Column (2).

STEP 10. BLOCK THREE, COLUMN (4)

Enter the difference between TTHS Adjusted Trained Personnel Required in Column (2) and Starting Inventory in Column (3) to determine Training Growth. The Training Growth may be positive or negative.

Training Growth - the difference between training requirements and starting inventory between one fiscal year and another. Inventory in excess of requirements will result in a negative growth; however, growth is normally positive.

STEP 11. BLOCK THREE, COLUMN (5)

Enter losses in the appropriate fiscal year from Block Two, Column (3).

TABLE 4-6. Worksheet for Phased Course Input Requirements (cont'd)

STEP 12. BLOCK THREE, COLUMN (6)

Enter the sum of Training Growth from Column (4) and Losses from Column (5) to determine Course Output Requirements.

STEP 13. BLOCK THREE, COLUMN (7)

Enter the product of Course Output Requirements from Column (6) and the Course Attrition Factor to determine Course Attrition.

Course Attrition Factor - a factor calculated from historical data used to inflate the Course Output Requirements to account for trainees who fail to complete a course of instruction for a variety of reasons. Course Attrition Factors differ from course to course; however a factor of 0.10 should be used in the absence of an empirical figure.

STEP 14. BLOCK THREE, COLUMN (8)

Enter the sum of Course Output Requirements from Column (6) and Course Attrition from Column (7) to determine Adjusted Course Input Requirements.

STEP 15. BLOCK THREE, COLUMN (9)

Enter the Backout in appropriate (+) or (-) column in accordance with the following procedure.

a. Compute the Backout Factor as a percentage by multiplying course length in weeks by two (2). (Note: This number is not entered on the worksheet.)

b. Multiply the Backout Factor by the Adjusted Course Input Requirements for the second fiscal year in Column (8). A Backout Factor is not computed for the first fiscal year.

c. Enter the backout computed in b. as a positive number for the first planning year in Column (9) and as a negative number for the second planning year in Column (9). This figure is a double entry as it represents both an additional input for the preceeding fiscal year and a backout for the current fiscal year.

d. Repeat steps b. and c. above for each fiscal year requiring Backout.

Backout Factor - a calculated figure applied to the Adjusted Course Input Requirements to account for overlapping of a course from one fiscal year to another. Courses with lengths in excess of two weeks and convened on a continuous basis re-

quire a portion of the input to be admitted the previous fiscal year in order to meet the required output of the following year. The Backout Factor is a percentage equal to twice the course length and is applied to each fiscal year with the exception of the first. The Backout Factor is not applied to courses less than two weeks in length.

STEP 16. BLOCK THREE, COLUMN (10)

Enter the sum of the Adjusted Course Input Requirements from Column (8) and the net Backout in Column (9) to determine the Final Adjusted Annual Training Input Requirements.

The example on the following page uses a Starting Inventory of zero, a four week course length, and the following factors and unadjusted requirements by fiscal year:

	TOTAL UNADJ TRAINED PERS REQ'D
FY88	61
FY89	103
FY90	148
FY91	183
FY92	196
FY93	196

TTHS factor: 1.09

Loss factor: .15

Course Attrition Factor: .10

Table 4-6. Worksheet for Phased Course Input Requirements (Continued)

BLOCK ONE

(1) FISCAL YEAR	(2) TOTAL UNADJ* TRAINED PERS REQ'D	(3) TTHS ADJ TRAINED PERS REQ'D
FY88	61	(61x109=)66
FY89	103	112
FY90	148	161
FY91	183	199
FY92	196	214
FY93	196	214

* CUMULATIVE

BLOCK TWO

(1) FISCAL YEAR	(2) STARTING INVENTORY	(3) LOSSES
FY88	0	0
FY89	66	(66x.15=)10
FY90	112	17
FY91	161	24
FY92	199	30
FY93	214	32

(1) FISCAL YEAR	(2) TTHS ADJ TRAINED PERS (TTHSA)	(3) STARTING INVENTORY (SI)	(4) TRAINING (+/-) GROWTH (TG) (TTHSA) - (SI)	(5) LOSSES (L)	(6) COURSE OUTPUT REQUIREMENTS (CO) (TG) + (L)	(7) COURSE ATTRITION (CA)	(8) ADJUSTED COURSE INPUT REQ (ACI) (CO) + (CA)	(9) BACKOUT (BO) (+)	(9) BACKOUT (BO) (-)	(10) FINAL ADJUSTED ANNUAL TRAINING INPUT REQ (ACI) + (BO)
FY88	66	0	66	0	66	(66x.10=)7	(66+7=)73	+5	–	78
FY89	112	66	(112-66=)46	10	(46+10=)56	6	62	+6	-5	(62+6-5=)63
FY90	161	112	49	17	66	7	73	+5	-6	72
FY91	199	161	38	24	62	6	68	+4	-5	67
FY92	214	199	15	30	45	5	50	+3	-4	49
FY93	214	214	0	32	32	3	35	+3	-3	35

$+5 = 62 \times \frac{4 \times 2}{100}$

BLOCK THREE

which can be used to document the results of the steady-state and phased algorithm applications is provided in Table 4-7.

After the worksheets have been completed, relevant data from these worksheets must be entered into the SDT. Table 4-8 displays the most desirable sequence for entering data into the SDT.

4.3 DETERMINE THE NUMBER OF INSTRUCTORS

OVERVIEW

During this procedure, the number of instructors required in each course is determined.

PROCEDURE

An algorithm for determining the number of instructors is presented in Table 4-9. This algorithm has been automated in the ETES Resource and Cost Estimation Techniques (see User's Guide: Resource and Cost Estimation Techniques). The algorithm should be applied for each location and year in which the course is given. A worksheet for documenting the results of the RCET is contained in Table 4-10. Table 4-11 displays guidelines for entering data into the SDT.

4.4 DETERMINE FACILITIES REQUIREMENTS

OVERVIEW

During this procedure, facilities requirements are determined.

Table 4-7. Number of Students To Be Trained Worksheet (NSTUD).

Course Title____________________

Course Number____________________

System____________________

(a) Location	(b) Steady State	(c) FY ______	(d) FY ______	(e) FY ______	(f) FY ______	(g) FY ______
TOTAL						

Table 4-8. Guidelines for Entering Data Into SDT (4.2).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
4.2	Number of Students to be Trained	Course	NSTUD	B thru G	2
4.2	Manpower Requirements	Course	NSSS	B	1

TABLE 4-9. ALGORITHM FOR DETERMINING NUMBER OF INSTRUCTORS

1. Determine the number of Instructor Contact Hours (ICH) per class.

$$\text{ICH per class} = \sum_{i=1}^{NM} \frac{\text{hours of method } i \times \text{class size}}{\text{student/instructor ratio for method } i}$$

where NM is the number of methods.

2. Determine the number of instructors.

$$\text{number of instructors} = \text{ICH per class} \times \frac{\text{course frequency}}{1250}$$

Table 4-10. Number of Instructors Worksheet (NINS).

Course Title____________________ System_______________________

Course Number______________________

(a) Location	(b) Steady State	(c) FY ______	(d) FY ______	(e) FY ______	(f) FY ______	(g) FY ______
TOTAL						

Table 4-11. Guidelines for Entering Data Into SDT (4.3).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
4.3	Number of Instructors	Course	NINS	B	1

PROCEDURE

An algorithm for determining facilities requirements is displayed in Table 4-12. A worksheet for applying the algorithms to a specific course location and year is contained in Table 4-13. A worksheet for summarizing the results for a specific course is displayed in Table 4-14.

4.5 DETERMINE TRAINING DEVICE AND TRAINING EQUIPMENT REQUIREMENTS

OVERVIEW

During this procedure, resource requirements are determined for training devices and training equipments.

PROCEDURE

An algorithm for determining the number of training devices is presented in Table 4-15. A worksheet for applying these algorithms is displayed in Table 4-16.

It should be noted that a training device can, by itself, be considered a large system acquisition with its own associated resource requirements. Estimation of these additional resource requirements is beyond the current scope of ETES. However, it is expected that these resource requirements could be estimated using comparability analysis. Input to the determination of training device resource requirements is provided by the task requirements associated with each device which are determined in Procedure 2.0 and the instructional programs developed during Procedure 4.5.

Table 4-12. Algorithm For Determining Training Facilities Requirements

$FR_i = MST \times FRS_i$

where FR_i is the total square footage of facilities requirements required for the i^{th} facility type, MST is the maximum student throughput and FRS_i is the number of square feet required per student for the i^{th} type of facility.

Maximum student throughput (MST) is calculated by the following equation

$MST = CS \times MNC$

where CS is the class size and MNC is the maximum number of courses conducted concurrently during the year.

If FRS_i is not available, it may be estimated through comparability analysis. More specifically, it can be calculated as follows:

$$FRS_i = \frac{TSF_i}{CS \times MNC}$$

where TSF_i is the total square footage in the comparable course for the i^{th} type of facility, CS is the class size for the comparable course, and MNC is the maximum number of classes conducted concurrently for the comparable course.

Table 4-13. Worksheet For Determining Training Facilities (DFAC).

Course ______________ System ______________

Facility	(A) Class Size	(B) Maximum Courses Per Year	(C) Maximum Student Throughput (axb)	(D) Square Feet Req. Per Student	Total Requirements (cxd)

Table 4-14. Facilities Requirements Worksheet (NFAC).

Course Title____________________

Course Number____________________

System____________________

(a) Location	(b) Steady State	(c) FY ______	(d) FY ______	(e) FY ______	(f) FY ______	(g) FY ______
TOTAL						

Table 4-15. Algorithm for Determining Number of Training Devices/Equipments Per Site.

1. Determine number of hours to be spent on device per day.

$$NSES * \left(\frac{NMAX}{NSTUD}\right) * \left(\frac{NCHOURS}{CLENGTH}\right) = NHRSD$$

NSES = Maximum number of sessions per start
NMAX = Maximum student/instructor ratio for course
NCHOURS = Number of hours to be spent on device for each student
CLENGTH = Course length, in days
NSTUD = Number of students who can be trained on device simultaneously
NHRSD = Number of hours to be spent on device per day

2. Determine number of devices required.

$$\frac{NHRSD}{SHIFT} = NDEVICE$$

NHRSD = Number of hours spent on device per day
SHIFT = Maximum operating hours per day per device
NDEVICE = Number of devices

3. Round NDEVICE TO NEXT HIGHEST INTEGER

Table 4-16. Worksheet For Determining Number of Training Devices/Equipments (TDEV).

Course ______________________ System ______________________

	A	B	C	D	E	F	G	H	I	J
Device/Equipment	Class Size Ratio	Number of Students	A+B	Instructor Hours/ Student	Course Length	D+E	Maximum Number Sessions Site	Number of Hours Per Day (GxCxF)	Maximum Operator Hours Per Day	Number of Devices (H+I)

The same algorithm used for training devices can be used for training equipment. Use of actual weapon system equipment for training will generate additional resource requirements. Again, determination of these resource requirements is beyond the present scope of ETES. However it is expected that comparability analysis could be used to determine such additional resource requirements.

A worksheet for summarizing the results of the application of the training device/equipment algorithms is provided in Table 4-17. Table 4-18 displays guidelines for entering data into the SDT.

4.6 DETERMINE REQUIREMENTS FOR OTHER TRAINING RESOURCES

OVERVIEW

During this procedure, resource requirements for media and instructional aids and ammunition are determined.

PROCEDURE

Procedures for determining resource requirements for media instructional aids and ammunition are provided in the sections which follow.

4.6.1 Determine Number of Training Aids/Instructional Media

There are two general algorithms for determining the number of instructional aids and other forms of instructional media directly assignable to a course: one algorithm for determining the number student-issued media and another algorithm for determining the number non-student-issued media.

Table 4-17. Training Device/Equipment Worksheet (DEEQ).

Course Title________________

Course Number________________

System________________

Device/Equipment________________

(a) Location	(b) Steady State	(c) FY ______	(d) FY ______	(e) FY ______	(f) FY ______	(g) FY ______
TOTAL						

Table 4-18. Guidelines for Entering Data Into SDT (4.5).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
4.5	Number of Training Devices/Equipment	MEDIA	DEEQ	B thru G	1

Student-Issued Media

Media issued to students (i.e., students consume the media during the course or take it with them when they leave) is determined by the following equation:

$$TMR_i - NS \times UR_i$$

where TMR_i is the total media requirements for the ith medium, NS is the number of students taking the course per year, and UR_i is the number of the ith media issued to each student (this number is usually one).

Non-Student Issued Media

Media which is not issued to students may be determined by the following equation:

$$TMR_i = MST \times UR_i$$

where TMR_i is the total resource requirements for the ith course, MST is the maximum student throughout the course and UR_i is the usage rate for the ith media. Maximum student throughput (MST) is calculated by the following equation:

$$MST = CS \times MNC$$

where CS is the class size and MNC is the maximum number of courses conducted concurrently during the year. A worksheet for determining the number of media and instructional aids is presented in Table 4-19. A worksheet for summarizing the results of this algorithm is presented in Table 4-20. Table 4-21 displays guidelines for entering data into the SDT.

Table 4-19. Worksheet for Determining Number of Media and Instructional Aids (NMED).

Course ______________________ System ______________________

Student Issued Media

Media	(a) Number of Students	(b) Number Issued Per Student	(c) Total Media (a x b)	

Non-Student Issued Media

Media	(A) Class Size (a)	(B) Maximum Courses Per Year (b)	(C) Maximum Student Throughput (a x b)	(D) Usage Rate	(E) Total Media (c x d)

Table 4-20. Number of Media/Aids (MEDSUM).

Course Title____________________

Course Number____________________

System____________________

Media/Aid____________________

(a) Location	(b) Steady State	(c) FY _____	(d) FY _____	(e) FY _____	(f) FY _____	(g) FY _____
TOTAL						

4.6.2 Determine Ammunition Requirements

To determine ammunition requirements for developing systems during the early phases of the acquisition process, comparability analysis procedures must be employed. More specifically, comparable courses must be identified and data on the ammunition requirements for these courses must be obtained. This data should be available in the ammunition annex in the Program of Instruction (POI) for each course. Ammunition requirements for a comparable course should be modified to reflect the task, methods/media, and operating and support plan differences between a comparable course and a new course. A comparable course should have been identified during the POI instruction process (see Procedure 3.6).

Table 4-21 lists a worksheet which can be used to support the modification of ammunition data from a comparable course.

Table 4-22 lists a worksheet which can be used to summarize ammunition requirements. Table 4-23 provides guidelines for entering data into the SDT.

Table 4-21. Ammunition Requirements Worksheet (AMREQ).

Course Number____________________ System____________________

Course Title____________________

Comparable Course Number____________________

Comparable Course Title____________________

DODIC	Item	Comparable Course				New Course		(h)
		No. Per Student		No. Per Class		No. Per Student	No. Per Class	
		(b) Peacetime	(c) MOB	(d) Peacetime	(e) MOB	(f) Peacetime	(g) MOB	Comments

Table 4-22. Ammunition Requirements Summary Sheet (AMSUM).

Course Number ____________ System ____________

Course Title ____________

DODIC ____________

Item ____________

(a) Location	(b) Steady State	(c) FY ____	(d) FY ____	(e) FY ____	(f) FY ____	(g) FY ____
TOTAL						

Table 4-23. Guidelines for Entering Data Into SDT (4.6).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
4.6	Number of Media/Aids	Media	MEDSUM	B thru G	1

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SECTION 5 - DETERMINE TRAINING COST

OVERVIEW

During this procedure, costs are estimated for the BCS and New system courses, and aggregate cost estimates are developed for the Predecessor, BCS, and New systems.

PROCEDURES

An overview of the procedures in this step is provided in Figure 5-1.

5.1 ESTIMATE INDIVIDUAL COURSE COST

OVERVIEW

During this procedure, costs are estimated for the BCS or New system courses. A worksheet which can be used to support this procedure is provided in Figure 5-2.

PROCEDURE

The first step in this procedure is to obtain the cost per graduate for each course and to enter this information into column (a) of the ICOST worksheet. For BCS or New system courses which are unmodified existing courses, the cost per graduate can be obtained directly from the Cost Analysis Program - MOS Training Costs (RCSATRM-159R1). Outputs from this program may be obtained from the Resource and Economic Analysis OPC, ATRM-R, in the DCS Resource Management - ATRM at TRADOC Headquarters. All course costs should be obtained from the latest version of the cost analysis program.

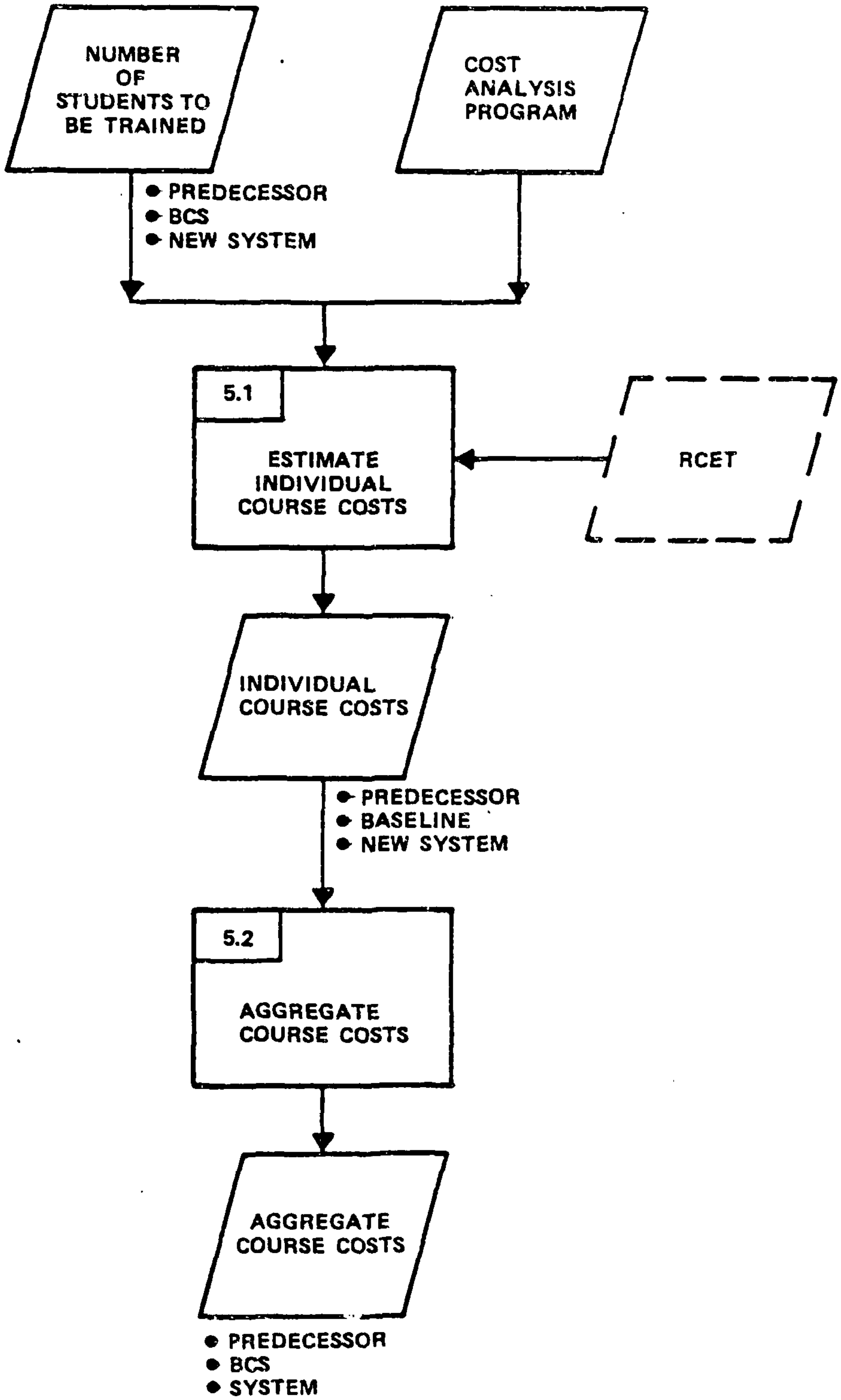

Figure 5-1. Overview Diag Determine Training Cost (5.1).

MOS____________________ System____________________

Course		Steady State		FY		FY		FY		FY		FY		(n) Total (Do Not Include Steady State)
	(a) Per Grad	(b) No. Grads	(c) Total	(d) No. Grads	(e) Total	(f) No. Grads	(g) Total	(h) No. Grads	(i) Total	(j) No. Grads	(k) Total	(l) No. Grads	(m) Total	
TOTAL														

Figure 5-2. Individual Course Cost Worksheet (ICOST).

Cost per graduate must be estimated for any modified or new course which is part of either the BCS or New system. These estimates can be obtained by applying the automated ETES Resource and Cost Estimation Technique (RCET). Using RCET, costs for a new or modified course are estimated by identifying a comparable existing course, obtaining cost data for this course from the ATRM system and then modifying this data to reflect the differences in key resource requirements (for example, number of instructors) between the comparable and new course. An overview of RCET is provided in Appendix B. A more detailed description of RCET is provided in the User's Guide: RCET.

Once the cost per grad has been determined for each course, the yearly number of students to be trained for both the steady state and phased conditions must be taken from the NSTD worksheet which was completed in Procedure 4.2 and entered into the appropriate columns in the ICOST worksheet. Yearly costs can then be calculated by multiplying the cost per grad (from column (a)) by the number of grads in each year.

Total costs per course can be obtained by summing over the years in which the course will be taught (do not include steady state costs in this calculation). In some situations, it may not be possible to estimate the phased graduate requirements (see Section 4.2). In these cases, it is not possible to estimate phased course costs.

It should be noted that the cost estimates developed during this step are only designed to provide input for training evaluation; these costs may not be appropriate for budgeting estimates.

After the ICOST worksheets have been completed, relevant data form these worksheets should be entered into the SDT. Table 5-1 describes the most desirable order for entering data into the SDT. Additional guidance for entering data into the SDT is provided in the SDT User's Guide.

5.2 AGGREGATE COURSE COSTS

OVERVIEW

During this step, courses costs are aggregated across MOSs to provide total cost measures for the Predecessor, BCS, and New systems. A worksheet (ACOST) which can be used to support this procedure is provided in Figure 5-3.

PROCEDURE

Total steady state course costs for each MOS are obtained directly from the subcost total under column (c) of the ICOST worksheet and entered into the appropriate column in the ACOST worksheet.

Similarly, the phased costs per year are obtained from the subtotals listed in column (m) of the ICOST worksheet and entered into the appropriate column in the ACOST worksheet. These costs are then summed across MOSs to provide a total cost value for the Predecessor, BCS and New systems.

Table 5-1. Guidelines for Entering Data Into SDT (5.1).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
5.1	Course Cost Per Grad	Course	ICOST	A	1

	Predecessor		BCS		New System	
(a) MOS	(b) Steady State	(c) Total Phased	(d) Steady State	(e) Total Phased	(f) Steady State	(g) Total Phased

Figure 5-3. Course Aggregation Worksheet (ACOST).

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SECTION 6.0 - ESTIMATE TRAINING EFFICIENCY/EFFECTI

During this procedure, training "efficiency" measu developed for three training program elements: (1) m training devices (the most expensive type of medi training methods (see Figure 6-1). In addition, e of the effectiveness of an entire training prog developed.

6.1 ESTIMATE TRAINING EFFICIENCY

OVERVIEW

Training efficiency provides a measure of how w characteristics of the tasks to be trained ma characteristics of a training program element (for media).[1] Training efficiency measures are easily est even during the early phases of the acquisition proc

PROCEDURE

An overview of this procedure is presented in Figu three efficiency measures are developed durin procedure (training media efficiency, training efficiency, and training method efficiency). Me method efficiency are assessed using procedures f Training Efficiency Estimation Model (TEEM).

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1 The concept of training efficiency (congruen task characteristics) was initially developed by Jo (1979) in the TEEM project.

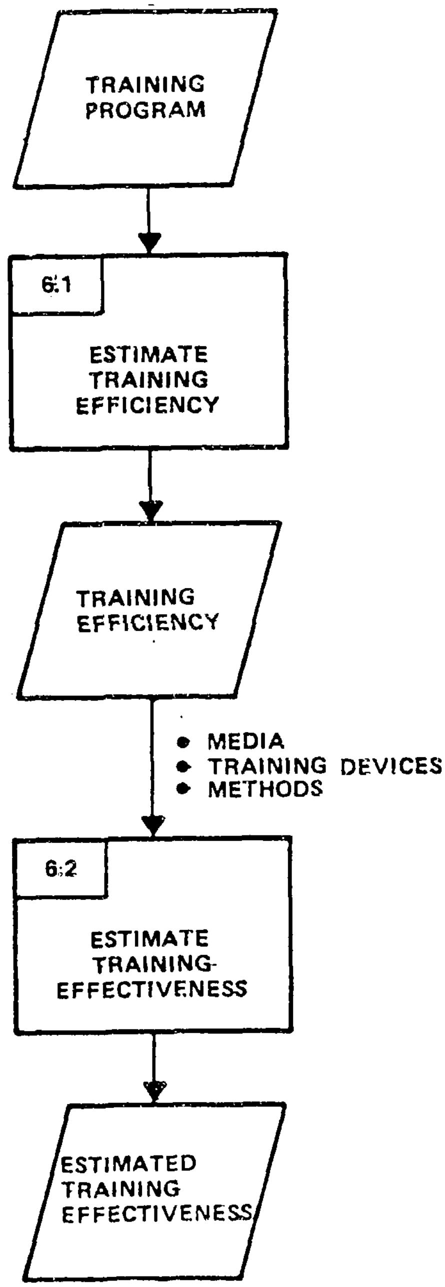

Figure 6-1 Overview Diagram: Estimate Training Efficiency/Effectiveness

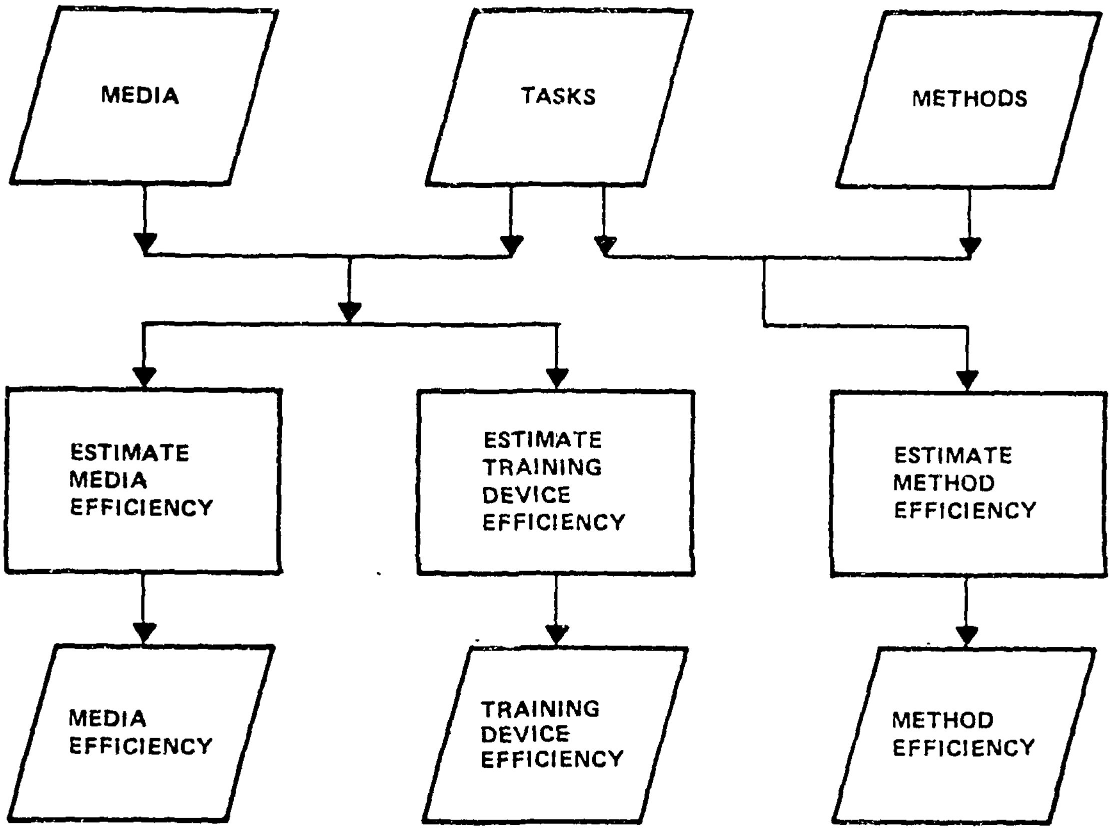

Figure 6-2 Overview Diagram: Estimate Training Efficiency

device efficiency is measured using procedures from the TRAINVICE methodology.

6.1.1 Estimate Media Efficiency

OVERVIEW

To estimate training efficiency for media, procedures from the TEEM model are employed. These procedures have been automated in the ETES Media Selection Program. An overview of the Media Selection Program is provided in Appendix A. A detailed description of the program is provided in the User's Guide: Media Selection Program. This guide contains a detailed description of the procedures for estimating media efficiency.

PROCEDURE

An overview of the procedure for estimating media efficiency is presented in Figure 6-3. To begin the procedure, tasks are rated on a set of variables describing the stimulus, response, and feedback variables. These ratings indicate which variables can be applied to each task (indicated by assigning a 1 or 0 to each task-variable combination). The maximum possible match that is appropriate for each task is then determined by adding up the number of 1's. (The applicability of task variables to each media category has already been determined and has been incorporated into the Media Selection Program).

The match between media and tasks is determined by counting the number of psychological variables they have in common. Training efficiency of each media is determined by dividing the actual match by the maximum possible match.

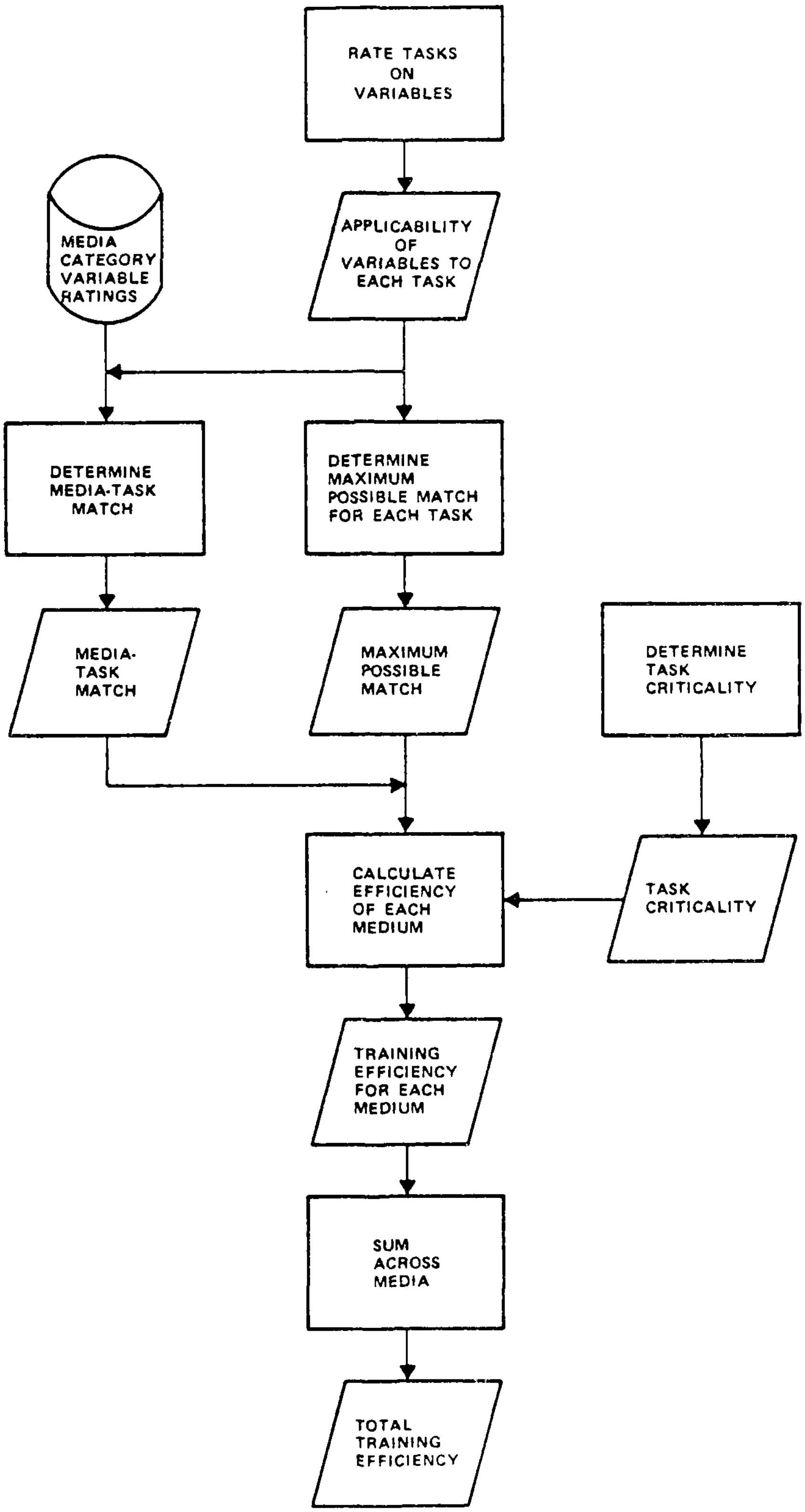

Figure 6-3. Overview Diagram: Determine Training Efficiency.

As an added feature, each task can be weighted by its task criticality during the calculation of efficiency using the following formula:

$$E_i = \sum_{j=1}^{n} \sum_{k=1}^{m} c_i \, m_{ijk}$$

where E_i is the efficiency of the ith MEDIUM, C_j is the criticality of the jth task, M_{ij} is the match between the ith medium and the jth task on the kth variable, N is the number of tasks assigned to the medium, and M is the number of psychological variables. Procedures for calculating task criticality are described in Procedure 3.1.

It should be noted that the Media Selection Program can also be used to assign tasks to media as well as to evaluate the efficiency of any given assignment. An overview of procedures for using the program to make media assignments is presented in Procedure 3.7.

6.1.2 Estimate Training Device Efficiency

OVERVIEW

Training devices are often the most expensive type of training media to provide more refined estimates of the efficiency of this critical type of training device, procedures from the TRAINVICE methodology may be employed.[2]

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[2] A detailed description of TRAINVICE is provided in the Training Device Requirements Guide.

PROCEDURE

Process: An overview of the steps in the TRAINVICE procedure is presented in Figure 6-4. First, a measure of task commonality (TC) is constructed by counting the number of tasks which can be trained on the device. Second, a measure of physical similarity (PS) is constructed by rating how well the physical features of the controls and displays of the device match the features on the control and devices of the operational equipment. Third, a measure of functional similarity (FS) is constructed by rating how well the information flow presented to students in each control displays matches the information flow for the same controls and displays in the operational equipment. Fourth, the improvement in skill and knowledge (SK) which can be expected for each device is determined. Fifth, the task training difficulty (TTD) of each task element is determined.

Finally, the total efficiency (called index of training device effectiveness in the TEEM model) of a training device is determined by the following formula:

$$\frac{\frac{TC + PS + PS}{3} + \frac{SK + TTD}{2}}{2}$$

A detailed description of the TRAINVICE procedure is provided in Appendix G. A worksheet which an be used to summarize the results of the TRAINVICE procedure is provided in Table 6-1. Table 6-2 describes guidelines for entering these summary results into the SDT.

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Table 6-1. TRAINVICE Summary Worksheet (TVICE).

System______________________

(a) Device	(b) MOS/Skill Level	(c) Course	(d) Index of Effectiveness	(e) Index of Personnel Requirements	(f) Overall Index of Effectiveness

Table 6-2. Guidelines for Entering Data Into SDT (6.1.2).

PROCEDURE	DATA ELEMENT	RELATED SDT ENTITY	RELATED WORKSHEET	WORKSHEET COLUMN(S)	SEQ #
6.1.2	Index of Effectiveness	Media	TVICE	D	1
6.1.2	Index of Personnel Requirements	Media	TVICE	E	1
6.1.2	Overall Index of Effectiveness	Media	TVICE	F	1

6.1.3 Estimate Training Method Efficiency

OVERVIEW

The same general procedures and algorithms used to assess media efficiency can be used to assess the efficiency of training methods. The major difference between the application of the procedures to methods rather than media is that a different set of varibles must be used to assess the match between methods and tasks.

PROCEDURE

An overview of the procedures for assessing the efficiency of training methods is presented in Figure 6-5. More details on the steps in this procedure are provided in the sections which follow.

- Rate Methods on Variables

Table 6-3 lists the instructional methods which are typically used in the Army. Any one course is likely to use some subset of these methods. The methods used in each course must be rated on set of variables which assess the match between the methods and tasks. A candidate listing of such variables is presented in Table 6-4.[3] The user should select five to twenty of these variables. The variables selected should be those which are most likely to discriminate between the methods included in the course.

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3 These are the variables used by Jorgensen (1979) in the TEEM project to assess the efficiency of training methods.

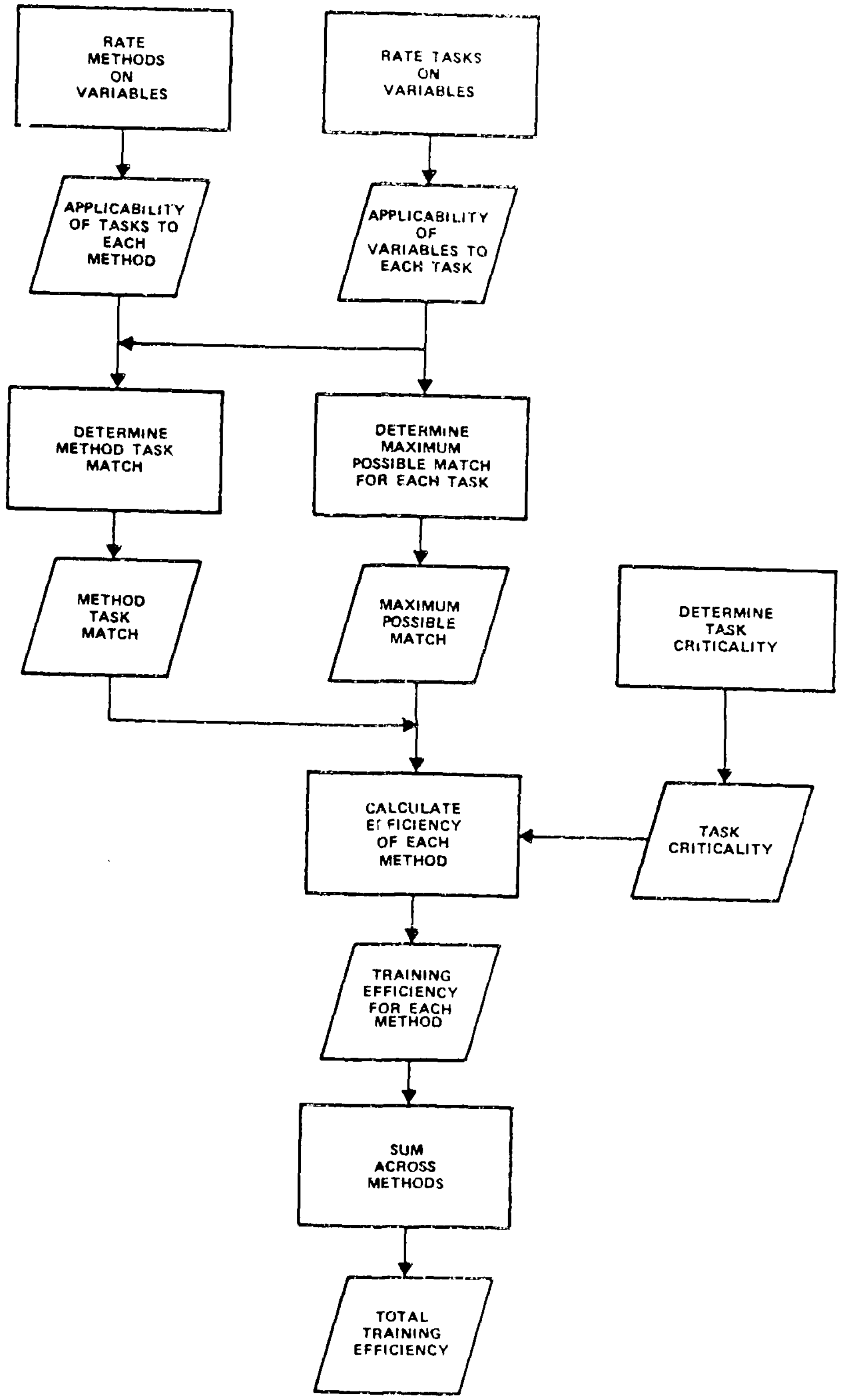

Figure 6-5 Overview Diagram: Generalized Procedures for Assessing Efficiency of Training Methods

Table 6-3. Method Alternatives.

AT	Audio Tape
C	Conference/Lecture
CAI	Computer Assisted Instruction
CS	Case Study
D	Demonstration
DF	Dual Flight Hours (only aviator courses) (do not include in ICH computations)
E1	Hardware Performance Examination
E2	Nonhardware Performance Examination
E3	Nonhardware Performance Examination
EL	Elective (in-house only, except for CGSC)
F	Film
GS	Guest Speaker
IS	Independent Study
NC1	Non-contact Instruction with an Instructor Available in Classroom
NC2	Non-contact Instruction without an Instructor Available
PE1	Hardware Oriented (hands-on) Practical Application
PE2	Nonhardware Oriented (non-classroom) Practical Application
PE3	Classroom Practical Application
PI	Programmed Instruction (using programmed text)
PM	Printed Materials
QC	Besseler Cue See
S	Seminar
SF	Solo Flight Hours (only aviator courses) (do not include in ICH computations)
SI	Simulation Instruction
SP	Self-Paced Instruction
ST	Slide Tape
TV	Television
WC1	Instructor Led Work Group
WC2	Student Led Work Group

Sources: DA Pam 570-558 Staffing Guide for U.S. Army Service Schools and TRADOC Cir 351-12 Format for Programs of Instruction

Table 6-4. Method-Related Variables*

Method Variables

STIMULI CHARACTERISTICS

Medium of Stimuli Presentation

1. Visual Cues - Signals received through the sense of sight.

2. Audio Cues - Signals received through the sense of hearing.

3. Tactile Cues - Signals received through the sense of touch, including sensations related to texture, size, shape, or vibration of the skin.

4. External Stimulus Motivation Cues - The sensations felt by a person when he is moved by some outside force in such a way that his body experiences roll, pitch, yaw, heave, sway and/or surge.

5. Internal Stimulus Motion Cues - The sensations felt by a person when he moves his arm, leg, fingers, etc.

6. Olfactile Cues - Signals received through the sense of smell.

7. Gustatile Cues - Signals received through the sense of taste.

Number of Channels or Sources

8. Limited - A small number of sources, channels, or instruments through which stimuli are presented to the trainee.

9. Unlimi[illegible] - A multiple number of sources, channels, or instruments throu[illegible] which stimuli are presented to the trainee.

Stimuli Pacing

10. Self-paced - Stimuli are only presented upon the trainee's request.

11. Forced-pace - Stimuli are presented at some predetermined rate, frequency of change, etc.

Stimuli Distribution

12. Individual - All information is presented or displayed directly to one individual trainee.

13. Group - Information is presented or displayed to a group of trainees, allowing only indirect access to the information for an individual.

* Taken from Jorgensen and Hoffer (1978)

Information Structure-Related Variables*

STIMULI CHARACTERISTICS

Medium of Stimuli Presentation

1. Visual Cues - Signals received through the sense of sight.
2. Audio Cues - Signals received through the sense of hearing.
3. Tactile Cues - Signals received through the sense of touch, including sensations related to texture, size, shape, or vibration of the skin.
4. External Stimulus Motion Cues - The sensations felt by a person when he is moved by some outside force in such a way that his body experiences roll, pitch, yaw, heave, sway and/or surge.
5. Internal Stimulus Motion Cues - The sensations felt by a person when he moves his arm, leg, fingers, etc.
6. Olfactile Cues - Signals received through the sense of smell.
7. Gustatile Cues - Signals received through the sense of taste.

Stimuli Presentation

8. Static - A unitary stimuli situation, i.e., stimuli are presented to the trainee "all at once", e.g., batch presentations.
9. Dynamic-Ordered - A sequential stimuli situation, i.e., stimuli are presented to the trainee sequentially or in an ordered manner over time.
10. Dynamic-Random - A non-sequential stimuli situation, i.e., stimuli are presented to the trainee randomly over time.

Stimuli Presentation Rate

11. Slow Rate - A slow rate or speed of presentation of stimuli to the trainee, allowing the trainee a long or maximum stimulus analysis time.
12. Fast Rate - A fast rate or speed of presentation of stimuli to the trainee, allowing the trainee a short or minimum stimulus analysis time.

Frequency of Stimuli Change

13. Infrequent - A low frequency of stimuli change, i.e., stimuli presented to the trainee change from one to another infrequently.
14. Frequent - A high frequency of stimuli change, i.e., stimuli presented to the trainee change from one to another frequently.

* Taken from Jorgensen and Hoffer (1978)

Table 6-4 (Continued)

Number of Stimuli

15. Few - A small number of separate streams of signals that occur independently of each other, but require simultaneous consideration.

16. Multiple - A large number of separate streams of signals that occur independently of each other, but require simultaneous consideration.

Stimuli Format

17. Formatted - Formatted or organized stimuli, such as alphanumeric displays.

18. Unformatted - Unformatted or unorganized stimuli, such as raw video displays.

Patterning of Stimuli

19. Simple - Simple or common patterns of stimuli, such as the repetition of the same event at high frequencies of occurrence.

20. Complex - Complex, detailed, or circumstantial patterns of stimuli, such as discrete sequenced patterns at low frequencies of occurrence.

RESPONSE CHARACTERISTICS

Response Mode of Implementation

1. Overt Response - Verbal - A response which the trainee expresses in an audible (verbal) manner, such as a verbal short answer response to a question having a limited set of correct answers, a conversational response, or a verbal decision response.

2. Overt Response - Written - A response which the trainee expresses in an observable (written) manner, such as a free style written response, a written multiple choice response, or a written fill-in-the-blank response.

3. Overt Response - Manipulative Acts - A response which the trainee expresses in an observable (manipulative) manner, such as the small movements of dials, switches, keys, or small adjustments to instruments or the large movements of levers, wheels or use of hand held tools.

4. Overt Response - Tracking - A response which the trainee expresses in an observable (tracking) manner, such as continuously controlling a constantly changing system, e.g., steering an automobile.

5. Overt Response - Procedural Performance - A response which the trainee expresses in an observable (procedural performance) manner, such as performing a sequence of steps in a procedure, e.g., carrying out the items on the checklist for preflighting an aircraft or turning on a radar system.

Table 6-4 (Continued)

6. Covert Response - A response which the trainee creates in his mind but does not express in an observable or audible manner.

Response Implementation

7. Static - A unitary response situation, i.e., responses are made by the trainee "all at once".
8. Dynamic-Ordered - A sequential response situation, i.e., responses are made by the trainee sequentially or in an ordered manner over time.
9. Dynamic-Random - A non-sequential response situation, i.e., responses are made by the trainee randomly over time.

Required Response Rate

10. Slow Rate - A slow rate or speed of trainee response, i.e., a rate which allows the trainee a long or maximum response time.
11. Fast Rate - A fast rate or speed of trainee response, i.e., a rate which allows the trainee a short or minimum response time.

Response Frequency

12. Infrequent - A low frequency of response change, i.e., responses made by the trainee change infrequently.
13. Frequent - A high frequency of response change, i.e., responses made by the trainee change frequently.

Number of Required Responses

14. Few - A small number of responses that the trainee is required to express, each independent of the other.
15. Multiple - A large number of responses that the trainee is required to express, each independent of the other.

Response Format

16. Formatted - Formatted responses, e.g., responses to a programmed text.
17. Unformatted - Unformatted responses, e.g., responses made by team members during an emergency situation.

Patterning of Responses

18. Simple - Simple or common patterns of responses, such as repetition of the same response at high frequencies of occurrence.
19. Complex - Complex, detailed, or circumstantial patterns of responses, such as discrete sequenced patterns of responses at low frequencies of occurrence.

Table 6-4 (Continued)

INFORMATION FEEDBACK LOGIC

Medium of Feedback Presentation

1. Visual - Feedback presented visually by means of a display, it may be coded and transmitted visually to the trainee.
2. Aural - Feedback presented aurally by means of a display to the trainee.
3. Written Form - Feedback presented to the trainee in written form.
4. Face-to-Face Communication - Feedback presented by direct verbal means to the trainee.
5. Indirect Communication - Feedback presented by indirect verbal means, such as by intercom, telephone, or radio link.
6. Tactile - Feedback presented to the trainee through the sense of touch, including sensations related to texture, shape, size, or vibration of the skin.
7. Kinesthetic - Feedback presented to the trainee by either internal or external bodily movement, such as reaching, grasping, tilting, etc.
8. Olfactile - Feedback presented to the trainee through the sense of smell.
9. Gustatile - Feedback presented to the trainee through the sense of taste.

Time Schedule for Feedback

10. Pre-F Interval - Immediate - Feedback provided immediately after the trainee's antecedent response, i.e., there is a small or no interval of time between the antecedent response and the feedback for that response.
11. Pre-F Interval - Delayed - Feedback provided subsequently after the trainee's antecedent response, i.e., there is an interval of time or delay between the antecedent response and the feedback for that response.
12. Post-F Interval - Immediate - Presentation of the next stimulus immediately after the occurrence of feedback for the last response, i.e., there is a small or no interval of time between the occurrence of feedback for the last response and the presentation of the next stimulus.
13. Post-F Interval - Delayed - Presentation of the next stimulus subsequently after the occurrence of feedback for the last response, i.e., there is an interval of time between the occurrence of feedback for the last response and the presentation of the next stimulus.

Table 6-4 (Continued)

Feedback Regularity

14. Regular - Feedback provided to the trainee at regular intervals, such as after every or every other response or at established or fixed periods.

15. Irregular - Feedback provided to the trainee at variable intervals, which may change as a function of stage of training or level of performance. This includes the provision for intermittent presentations to permit probabilistic schedules for reinforcement.

Frequency of Feedback

16. Frequent - Any feedback given to the trainee that is provided at least for 20-30% of all his responses.

17. Infrequent - Any feedback given to the trainee that is provided less than for 20% of all his responses or is not provided at all.

Feedback Format

18. Formatted - Formatted feedback, e.g., alphanumeric feedback displays.

19. Unformatted - Unformatted feedback, e.g., raw video feedback displays.

Table 6-4 (Continued)

Response Criterion

14. Determinate - The response criterion has a fairly explicit or implicit response requirement as a direct reflection of the training or system requirement, and makes the stimulus (visual, audio, etc.) possess a certain or determinate value or payoff for the trainee.

15. Indeterminate - The response criterion is highly dependent on the trainee's interpretation of the response requirement, and makes the stimulus (visual, audio, etc.) possess an uncertain or indeterminate value or payoff for the trainee.

RESPONSE CHARACTERISTICS

Response Mode of Implementation

1. Overt Response - Verbal - A response which the trainee expresses in an audible (verbal) manner, such as a verbal short answer response to a question having a limited set of correct answers, a conversational response, or a verbal decision response.

2. Overt Response - Written - A response which the trainee expresses in an observable (written) manner, such as a free style written response, a written multiple choice response, or a written fill-in-the-blank response.

3. Overt Response - Manipulative Acts - A response which the trainee expresses in an observable (manipulative) manner, such as the small movements of dials, switches, keys, or small adjustments to instruments or the large movements of levers, wheels or use of hand held tools.

4. Overt Response - Tracking - A response which the trainee expresses in an observable (tracking) manner, such as continuously controlling a constantly changing system, e.g., steering an automobile.

5. Overt Response - Procedural Performance - A response which the trainee expresses in an observable (procedural performance) manner, such as performing a sequence of steps in a procedure, e.g., carrying out the items on the checklist for preflighting an aircraft or turning on a radar system.

6. Covert Response - A response which the trainee creates in his mind but does not express in an observable or audible manner.

Table 6-4 (Continued)

Response Pacing

7. Self-paced - Responses are made by the trainee at his own rate.
8. Forced-pace - Responses are made by the trainee at some predetermined rate or frequency.

Response Distribution

9. Individual - All responses are expressed by one individual trainee.
10. Group - Responses are expressed by a group of trainees, allowing only indirect responses for an individual.

Response Determinancy

11. Determinant - A required response which can be specified in advance of the stimuli that calls the response out, i.e., the response is preprogrammed or determined before the operation begins.
12. Indeterminant - A required response which cannot be specified in advance of the stimuli that calls the response out, i.e., the response is highly dependent on the immediate stimuli situation and cannot be predicted in advance, hence is indeterminate.

INFORMATION FEEDBACK LOGIC

Medium of Feedback Presentation

1. Visual - Feedback presented visually by means of a display, it may be coded and transmitted visually to the trainee.
2. Aural - Feedback presented aurally by means of a display to the trainee.
3. Written Form - Feedback presented to the trainee in written form.
4. Face-to-Face Communication - Feedback presented by direct verbal means to the trainee.
5. Indirect Communication - Feedback presented by indirect verbal means, such as by intercom, telephone, or radio link.
6. Tactile - Feedback presented to the trainee through the sense of touch, including sensations related to texture, shape, size, or vibration of the skin.
7. Kinesthetic - Feedback presented to the trainee by either internal or external bodily movement, such as reaching, grasping, tilting, etc.
8. Olfactile - Feedback presented to the trainee through the sense of smell.
9. Gustatile - Feedback presented to the trainee through the sense of taste.

Table 6-4 (Continued)

<u>Source of Feedback</u>

10. <u>Intrinsic F</u> - Information or cues built into the system from which the trainee interprets feedback information.

11. <u>Extrinsic F</u> - Information or cues not inherent in the trainee action or system operations but is supplied by an external source.

<u>Feedback Pacing</u>

12. <u>Self-paced</u> - Feedback presented to the trainee only at his request.

13. <u>Forced-pace</u> - Feedback presented to the trainee at some predetermined rate, frequency, etc.

<u>Feedback Distribution</u>

14. <u>Individual</u> - Feedback is presented to one individual trainee.

15. <u>Group</u> - Feedback is presented to a group of trainees, allowing only indirect access for an individual.

Table 6-4 Functional Context Variables *

ROLE OF ELEMENT - The social function performed by the trainee within the system's operational context.

1. Supervisory - The trainee's function is unequal to functions being performed by other individuals; the role is basically one of overseeing or directing.

2. Team Performance - The trainee's function is equal to functions being performed by other individuals; the function is basically one of teamwork and cooperation.

3. Individual Performance - The trainee's function is one of performing alone, usually without supervision or team assistance.

FUNCTION PERFORMED IN ROLE - The primary actions performed within each role.

4. Mental - An action occurring or experienced in the trainee's mind, as contrasted with overt physical activity.

5. Physical - An overt bodily action performed by the trainee.

6. Perceptual - An action by the trainee involving perception or observation.

7. Communicative - An action by the trainee in which he transmits either a written or verbal message.

STABILITY OF FUNCTION - The function's state, quality, or degree of being constant over time.

8. Unstable - The trainee's function is not constant or regular, it is characterized by continual change and fluctuation.

9. Stable - The trainee's function has little change or fluctuation over time.

PHYSICAL CONTEXT - The significance of the physical environment upon performance of the task.

10. Low Impact - The physical environment has little or no significant impact on performance of the task.

11. High Impact - The physical environment has a large or significant impact on performance of the task.

PSYCHOLOGICAL IMPACT - The significance of the psychological environment upon performance of the task.

12. Low Impact - The psychological environment has little or no significant impact on performance of the task.

13. High Impact - The psychological environment has a large or significant impact on performance of the task.

* Taken from Jorgensen and Hoffer (1978)

Once the variables have been selected, each method must be rated in terms of whether or not the variable applies to that method. Table 6-5 contains a worksheet which can be used to make these ratings. The entries in the worksheet would be one if the variable applies to the method and zero if it does not.

o Rate Tasks on Variables

Each of the tasks to be trained must be rated on the same variables used to assess training methods. Table 6-6 contains a worksheet which can be used to make these ratings. The entries in the worksheet should be one if the variable applies to the method and zero if it does not.

o Determine Method-Task Match

The match between a task and an instructional method is determined by counting the number of times the same variable is rated as applying to both the method and the media (see Table 6-7).

o Determine Maximum Possible Match Between Each Task

The maximum possible match for a task is determined by counting the number of variables which were rated as applying to a task (see Table 6-6).

o Calculate Efficiency of Each Method

Total efficiency for a method is determined by dividing the method-task match score by the maximum possible match (see the worksheet listed in Table 6-7) to produce an efficiency

Table 6-5. Method Rating Worksheet (METH).

Course Number____________________

Course Title____________________

System____________________

(a) Methods	(b) Method Variables																																				

Table 6-6. Task Rating Worksheet for Instructional Methods (TAMOD).

Course Number________________

Course Title________________

System________________

(a) Tasks	(b) Method Variables																																				

Table 6-7. Worksheet for Calculating Method Efficiency (METHEFF).

Course Number________________

Course Title________________

System________________

	METHODS														
	________					________					________				
(a) Tasks	Method-Task Match	Maximum Match	Efficiency	Criticality	Weighted Efficiency	Method-Task Match	Maximum Match	Efficiency	Criticality	Weighted Efficiency	Method-Task Match	Maximum Match	Efficiency	Criticality	Weighted Criticality
TOTAL EFFICIENCY PER METHOD	X	X		X		X	X		X		X	X		X	

score for each method-task combination and then summing across tasks.

- Determine Task Criticality

As an added feature, each task can be weighted by its task criticality during the calculation of total efficiency for a method (see Table 6-7). Procedures for calculating task criticality are described in Procedure 3.1.

- Sum Across Methods

Total efficiency for a course can be determined by summing across the efficiency scores for each method.

6.2 ESTIMATE TRAINING EFFECTIVENESS

OVERVIEW

This procedure can be used to develop a rough measure of the effectiveness of a training course during the early phases of the acquisition process. In this procedure, subject matter experts are used to estimate the percentage of soldiers who will pass the criterion for each task. More specifically, a group of subject matter experts is presented with the following information for each task: (a) the target population description of the personnel who will perform the task, (b) a description of the task including its associated conditions, job performance standards, and general skills and knowledges, (c) a description of the training program or training program elements (e.g., methods, media) that will be used to train the task, (d) the criterion which must be achieved for the task (if different from the job performance

measure), and (e) the training time to be devoted to the task. Each SME is then asked to estimate the expected percentage of soldiers in target population who will pass the criterion given that training program. A total effectiveness measure for a course can be constructed by averaging the effectiveness scores associated with each task.

PROCEDURE

An overview of the procedure for estimating effectiveness is presented in Figure 6-6. A more detailed description of the steps in this procedure is provided in the sections which follow:

- Select Subject Matter Experts

To provide usable estimates of effectiveness, a subject matter expert must (1) have at least two years experience in performing the task or other comparable tasks and (2) have at least two years experience in Army training developments. As many individuals as possible who meet the above criteria should be selected (admittedly, this number will not be large).

- Complete Rating Forms

Table 6-8 presents a rating form which can be used to elicit the estimates of effectiveness. One of these forms should be filled out for each task in the training program. Obtaining the information to put in the forms should be relatively straightforward since all of this information should have been developed in previous ETES procedures.

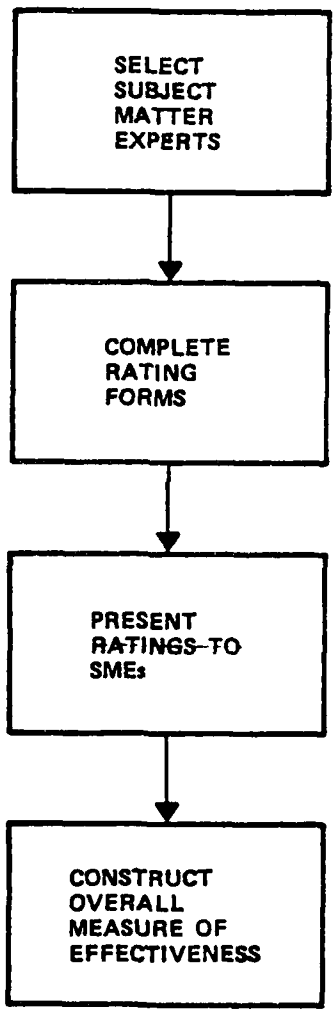

Figure 6-6 Overview Diagram: Estimate Training Effectiveness

Table 6-8. Form for Rating Effectiveness.

Task Description

Task Number: ____________________

Task: ____________________

Comparable Task: ____________________

Conditions: ____________________

____

____

Standards: ____________________

____

____

Major Skills and Knowledges: ____________________

____

____

____

____

Training Course ____________ Module ____________

Training Methods	Training Time	Media
	Total	

Criterion

____

____

____

What percentage of soldier can be expected to pass the criterion given the training program?

____

Table 6-9 describes the ETES procedures where each item in the rating form are generated.

- Present Ratings to SMEs

Each subject matter expert should be presented with the rating forms for all of the tasks in the course. Prior to the presentation of these forms, the SME should be given the QPOI (Procedure 3.6) and target population description (Procedure 3.4) for the course. Each SME should be instructed to leave the form blank if he/she is not familiar with the task or the comparable existing task.

- Construct Overall Measures of Effectiveness

Table 6-10 provides a worksheet which can be used to develop an overall effectiveness measure for a course. Training effectiveness estimates should be taken from the effectiveness rating form and entered into columns (a) and (b), respectively. Mean scores should be calculated across SMEs and entered into column (c). The total of these mean scores (item d) should then be calculated and divided by the number of tasks to provide an overall measure of course effectiveness.

Table 6-9 Guidelines for Developing Elements in Training Effectiveness Form

ELEMENT	RELATED ETES PROCEDURE
Task Number and Title	2.2, 2.4
Comparable Task	2.2, 2.4
Conditions, Standards	2.2, 2.4
Skills and Knowledges	3.3
Training Methods and Media	3.6
Training Times	3.6
Course	3.6
Setting	3.2
Criterion	3.6

Table 6-10. Worksheet for Calculating Overall Effectiveness Score (EFF).

Course Number____________________ Page____________________

Course Title____________________ Number of Tasks (NT)____________________

System____________________

(a) Tasks	(b) Effectiveness Estimates										(c) Mean
	SME-1	SME-2	SME-3	SME-4	SME-5	SME-6	SME-7	SME-8	SME-9	SME-10	

(d) TOTAL______ ÷ NT = ______ (e) Course Effectiveness

SECTION 7.0 EVALUATE TRAINING PROGRAM

OVERVIEW

This procedure provides techniques for evaluating the training program which was developed in the earlier ETES procedures.

PROCEDURE

This procedure consists of six lower level procedures. An overview of these procedures is presented in Figure 7-1.

In the first procedures, eight figures-of-merit for evaluating the "goodness" of a training program are developed. In the second procedure, these figures-of-merit are used to identify likely problem areas in the training program. In the third procedure, the likely causes of the problem areas are identified In the fourth and fifth procedures, methods are provided for identifying and evaluating training alternatives. In the sixth procedure, the impact of the system changes are determined

7.1 DEVELOP FIGURES-OF-MERIT

During this procedure training Figures-of-Merit are developed to evaluate the training courses developed in the previous ETES procedures. A listing of the Figures-of-Merit which may be used to evaluate the training course estimates during the earliest phases of the acquisition process is presented in Table 7-1. A training Figure-of-Merit provides

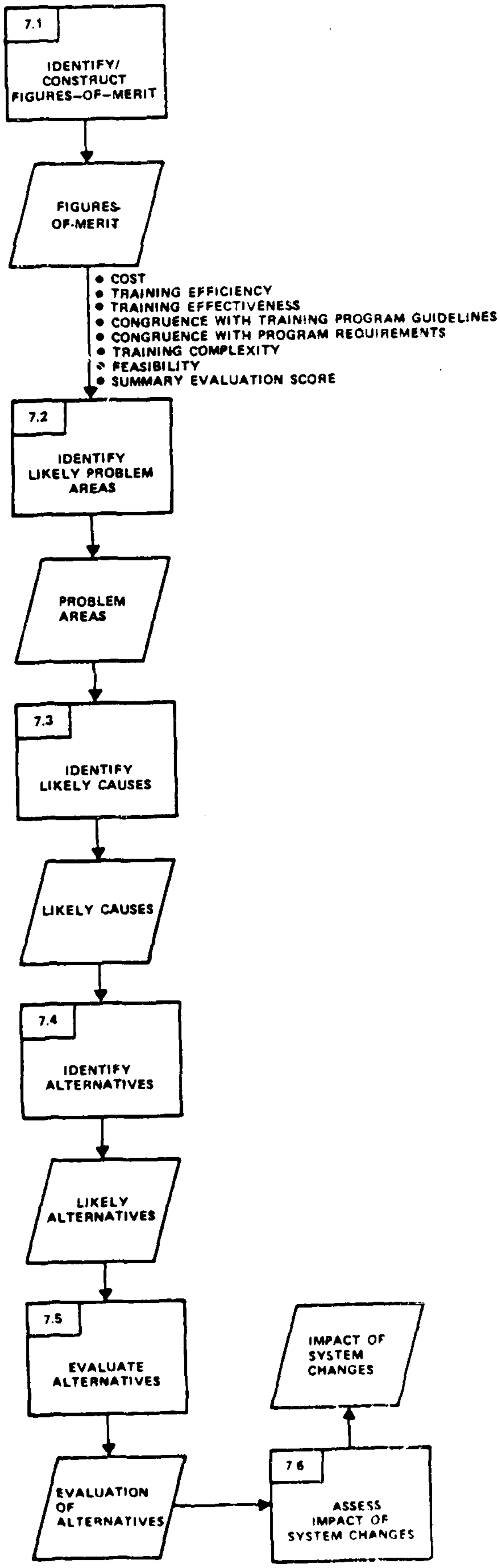

Figure 7-1. Overview Diagram: Evaluate Training Program (7.0).

Table 7-1. Potential Training Figures of Merit

1. Cost - the cost of the training program or training program element as determined in ETES.

2. Training Efficiency - a measure of how well the training program matches the task requirements of the system. Training efficiency is determined by comparing the characteristics of the tasks to be trained with the characteristics of the training program element.

3. Training Effectiveness - training effectiveness is measured by assessing the proficiency of the soldiers who experience the training program element.

4. Congruence with Training Development Guidelines - a measure of the degree to which the training program has been constructed in accordance with recommended or specified principles of Army instructional system's development.

5. Congruence with Program Requirements - a measure of how well the training program matches requirements outlined in requirements documents (e.g., JMSNS, LOA, TDLOA) or in request for proposals. This measure is not applicable unless meaningful statements of training requirements have been developed.

6. Training Complexity - a measure of the training complexity of a particular system or system element. Training complexity is determined by summing the training man-days associated for each course associated with the system.

7. Feasibility - a composite measure assessing (a) the technical risk associated with development of the training program and (b) the likelihood that the training program can be developed within existing resource, cost, and schedule constraints.

8. Summary Evaluation Score - a summary measure combining the three key training figures-of-merit -- cost, effectiveness, and complexity.

a summary measure of the "goodness" of a training program or course. In most cases, the training Figures-of-Merit will be developed to summarize the "goodness" of course. In some cases, however, they may be applied to the elements of a course. Table 7-2 lists the training program or course elements which are likely to be evaluated during the early phases of the acquisition process and describes which of the figures-of- merit are most appropriate for evaluating each course element.

The training figures-of-merit can be used to evaluate the training-related impacts of changes to non-training system elements such as changes in manpower and personnel assignments and requirements, changes in system hardware/ design, and the overall system schedule and budget. Table 7-2 indicates which training figures-of-merit can be used to assess the impacts of each of these non-training system elements. A more detailed discussion of procedures for using training figures-of-merit to assess changes in overall system design is presented under Procedure 7.6.

Of course, the individual training figures-of-merit are not independent of one another. Figure 7-2 presents an overview of the casual relationships among the training figures of merit. A more detailed discussion of these casual relationships is presented under Procedure 7.3.

Procedures for estimating training cost, efficiency, and effectiveness were presented under Procedures 5.0, 6.1, and 6.2, respectively. During this procedure, procedures are provided for estimating the other Figures-of-Merit listed in Table 7-1.

Table 7-2. System Elements and Applicable Figures of Merit.

System Element	Cost	Efficiency	Effectiveness	Congruence with Training Development Guidelines	Congruence with Program Requirements	Training Complexity	Feasibility	Summary Evaluation Score
Training Settings	•	•	•	•	•	•	•	•
Methods	•	•	•	•	•	•	•	•
Media	•	•	•	•	•	•	•	•
Course Sequencing (between course)	•		•	•	•		•	•
Training Times	•		•		•	•	•	•
Course Scheduling (within course), Frequency and Locations	•	•		•			•	•
Usage Rates for Training Resources	•			•			•	•
Assignment of Tasks to MOS, Duty Position, and Skill Level	•		•			•		•
MOS/Selection Requirements	•		•			•		•
Hardware/Software Design	•		•			•		•
System Schedule and Budget	•						•	•

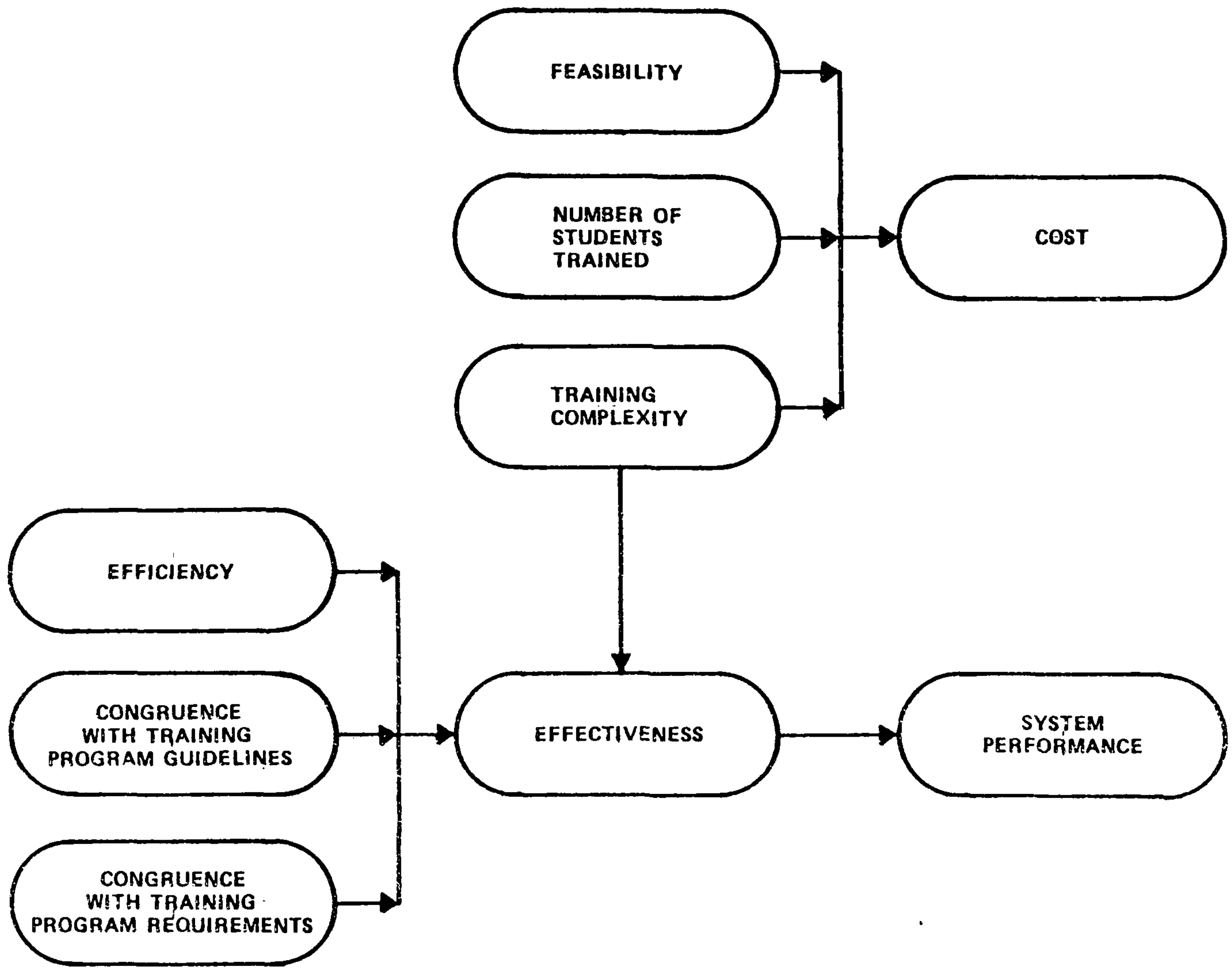

Figure 7-2 Overview of Relationships Among Training Figures of Merit

The user should select which figures-of-merit will be applied to each training program element as part of development of the ETES study plan, (see Section I.6).

7.1.1 Assess Congruence with Training Development Guidelines

OVERVIEW

Several documents have been produced to guide Army training developers in developing training programs for emerging systems. These documents represent the collective wisdom and expertise of the training development community. One can assume that training programs which have been developed in accordance with these guidelines are likely to be more effective than training programs which are not. This figure-of-merit provides a measure of the congruence between the procedures actually used to develop the training program element and the procedures prescribed in existing guidelines. This figure-of-merit can play an important role in assessing the training products developed by outside contractors. Obviously, if this measure is to have any credibility, it should not be assessed by the same organization which developed the training program.

PROCEDURE

An overview of the procedure for measuring the congruence between the actual procedures used to develop the training program element and the prescribed procedures is presented in Figure 7-3. First, existing documents containing guidance for developing the particular type of training program elements under investigation are identified. A

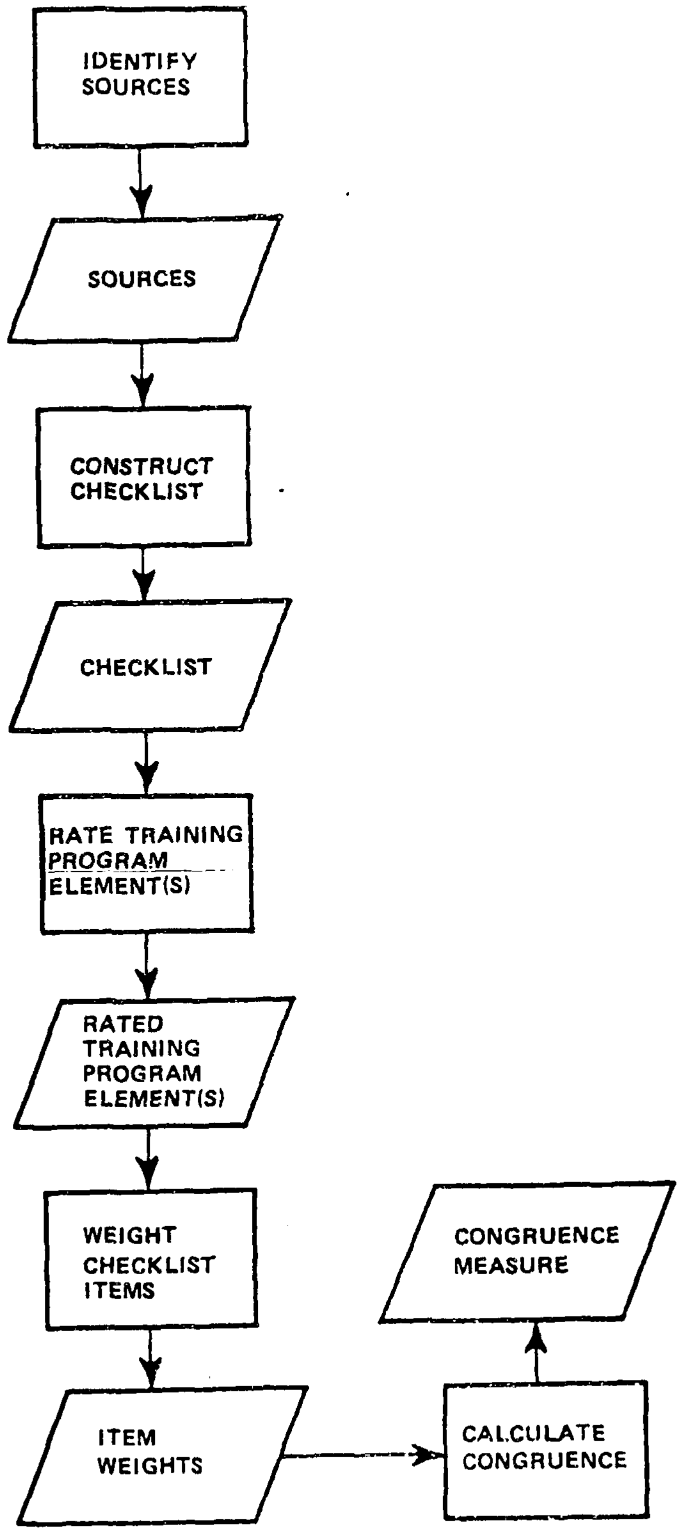

Figure 7-3 Overview of Diagram: Construct Measure of Congruence Between Actual and Prescribed Training Development Practices

preliminary list of such sources can be generated by examining the sources listed in Table 2-3 and the list of references provided at the end of this guide. Additional guidance is provided in the Army ISD job aids developed by Schulz and Farrell (1980).

Once the sources have been identified, a checklist must be developed specifying the observable features that the training program element would display if it was developed in accordance with the guidelines specified in the sources. An example checklist is provided in Table 7-3.

Once the checklist has been developed, each program element must be rated as to whether it displays the characteristic required in each item on the checklist. Following this, the importance of each item on the checklist should be assessed using the following scale:

1. Not at all Important
2. Somewhat Important
3. Moderately Important
4. Important
5. Extremely Important

Completion of the checklist and the importance ratings should be done by training analyst who have at least three years experience in Army training developments. Importance ratings should be averaged across rates. An item should be rated as meeting existing guidelines if a majority of the analysts rate the item as meeting requirements.

Once the importance of the items has been determined, a general measure of the congruence between actual and

Table 7-3. Example of Checklist for Assessing Congruence Between Actual and Prescribed Guidelines.

Checklist for Adequacy of Task Statements

System___________________

(a) Task	Action				Object	
	Observable	Measurable	Verifiable	Reliable	Specific	Appropriate Terminology
TOTAL TASKS						
TOTAL MATCHS						

prescribed training development procedures can be developed using the following algorithm:

$$CTD = \sum_{k=i}^{M} I_k \; D_k$$

where CTD is the general congruence measure, I_k is the importance of the kth checklist item; D_k equals 1 if there is a match between the actual and prescribed practice for the kth checklist item and 0 otherwise; and k is the number of checklist items.

Table 7-4 displays a worksheet which can be used to support the development of the training congruence Figure-of-Merit.

7.1.2 Assess Congruence with Program Requirements

It is possible that requirements relating to the training program may be included in system requirements documents (e.g., JMSNS, LOA). Such requirements may also be included in the request for proposals (RFPs) associated with the system. One measure of the "goodness" of the training program is the extent to which it meets these requirements.

This figure-of-merit can play an important role in evaluating contractor developed training program elements.

It should be noted that this measure is less meaningful when the organization setting the requirements is also the same organization producing the training program element.

Table 7-4. Worksheet for Measuring Congruence with Training Development Guidelines (CONDEV).

System__________ Alternative__________

Course Number__________

Course Title__________

(a) Item	(b) Importance	(c) Weighted Score

Total__________

PROCEDURE

The first step is to identify training-related requirements by examining existing system requirements documents (JSMSN, LOA, ROC, TDLOA, TDR) and/or contractor Request for Proposals. Second, a checklist must be developed specifying the observable components of each requirement. Third, each training program element must be rated on the extent to which it meets the specified requirements. Fourth, the importance of each requirement should be assessed using the following scale.

1 = Not At All Important
2 = Somewhat Important
3 = Moderately Important
4 = Important
5 = Extremely Important

Congruence with requirements can then be determined using the following algorithm:

$$CR = \sum_{k=1}^{M} I_k R_k$$

where CR is the general congruence measure; I_k is importance of the kth requirement, R_k equals 1 if the training program meets the requirement and 0 if it does not, and K is the number of requirements.

A generic checklist is provided in Table 7-5. A worksheet which can be used to support the development of this figure-of-merit is displayed in Table 7-6. Completion of the checklist and the importance ratings should be done by training analysts who have at least three years experience in Army training developments. Importance ratings should be averaged across raters. A item should be rated as meeting

Table 7-5. Generic Checklist for Assessing Congruence with Program Requirements.

System____________________

Program Requirement	Training Program Score	Requirement Met (Yes/No)

Table 7-6. Worksheet for Measuring Congruence with Program Requirements (CONPROG).

System____________________

Course Number____________________

Course Title____________________

Alternative____________________

(a) Item	(b) Importance	(c) Weighted Score

Total____________________

existing guidelines if a majority of the analysts rate the item as meeting requirements.

7.1.3 Assess Training Complexity

OVERVIEW

During the early phases of the acquisition process, it is important to identify the system elements which generate excessive or complex training requirements. By constructing a measure of training complexity of each system element training developers can help materiel developers in identifying potential design problems. A relatively single measure of training complexity which can be used during the early phases of the acquisition process is training time (course length).

PROCEDURE

Training complexity is initially determined for each course associated with the system. A summary complexity measure for each MOS is determined by summing the length of the courses associated with the MOS. The training complexity of a system may be determined by summing the length of the courses for all MOSs required to operate or maintain each of the component subsystems.

The training complexity measures for each MOS can be examined to identify the system areas with excessive requirements (see procedure 7.2 for more guidance on procedures for identifying problem areas). A worksheet which can be used to summarize the training complexity measure is provided in Table 7-7.

Table 7-7. Worksheet for Summarizing Training Complexity (CPLEX).

System____________________ Alternative____________________ Page____________________

Course	MOS	Length	Course	MOS	Length	Course	MOS	Length
MOS Total			MOS Total			MOS Total		
MOS Total			MOS Total			MOS Total		
MOS Total			MOS Total			MOS Total		
TOTAL								

7.1.4 Assess Feasibility

OVERVIEW

One important factor to consider in assessing the "goodness" of training program is its feasibility - i.e., the estimated likelihood that the training program element can be developed within existing technical, cost, resource, and schedule constraints. The feasibility of a training program consists of four components:

(1) Technical Feasibility - the likelihood than any new or modified technologies in the training program can be developed given the current state-of-the-art in training technology. If existing technologies are employed, this factor is not relevant.

(2) Cost Feasibility - the likelihood that a training program or training program element can be developed and maintained within the existing budget allotted to training development and operation.

(3) Resource Feasibility - the likelihood that a training program can be developed and implemented given the availability of critical training resources (e.g., instructors).

(4) Schedule Feasibility - the likelihood that a training program can be developed in accordance with required system schedule milestones.

PROCEDURE

An overview of the procedures for assessing the feasibility of a training program or set of training program elements is provided in Figure 7-4.

First, the training program elements are rated on the feasibility scales listed in Table 7-8. Second, weights are developed to reflect the user's perception of the importance of each of the scales. (The sum of the weights assigned should equal 1.0). Third, an overall feasibility score is determined using the following algorithm.

$$F = \sum_{i=1}^{N} W_i \, S_i$$

where F is the overall feasibility score, W is the weight attached to the ith scale, S is the score on the ith scale, and N on the number of scale items. A worksheet to support the construction of the feasibility score is provided in Table 7-9.

The feasibility ratings should be obtained from training analyses who have at least three years experience in Army training developments. Ratings should be averaged across raters.

7.1.5 Construct Summary Evaluation Score

OVERVIEW

During this procedure, a summary evaluation score is constructed which aggregates scores on the three most critical training figures-of-merit: cost, effectiveness, and training complexity. To accomplish this, scores for the

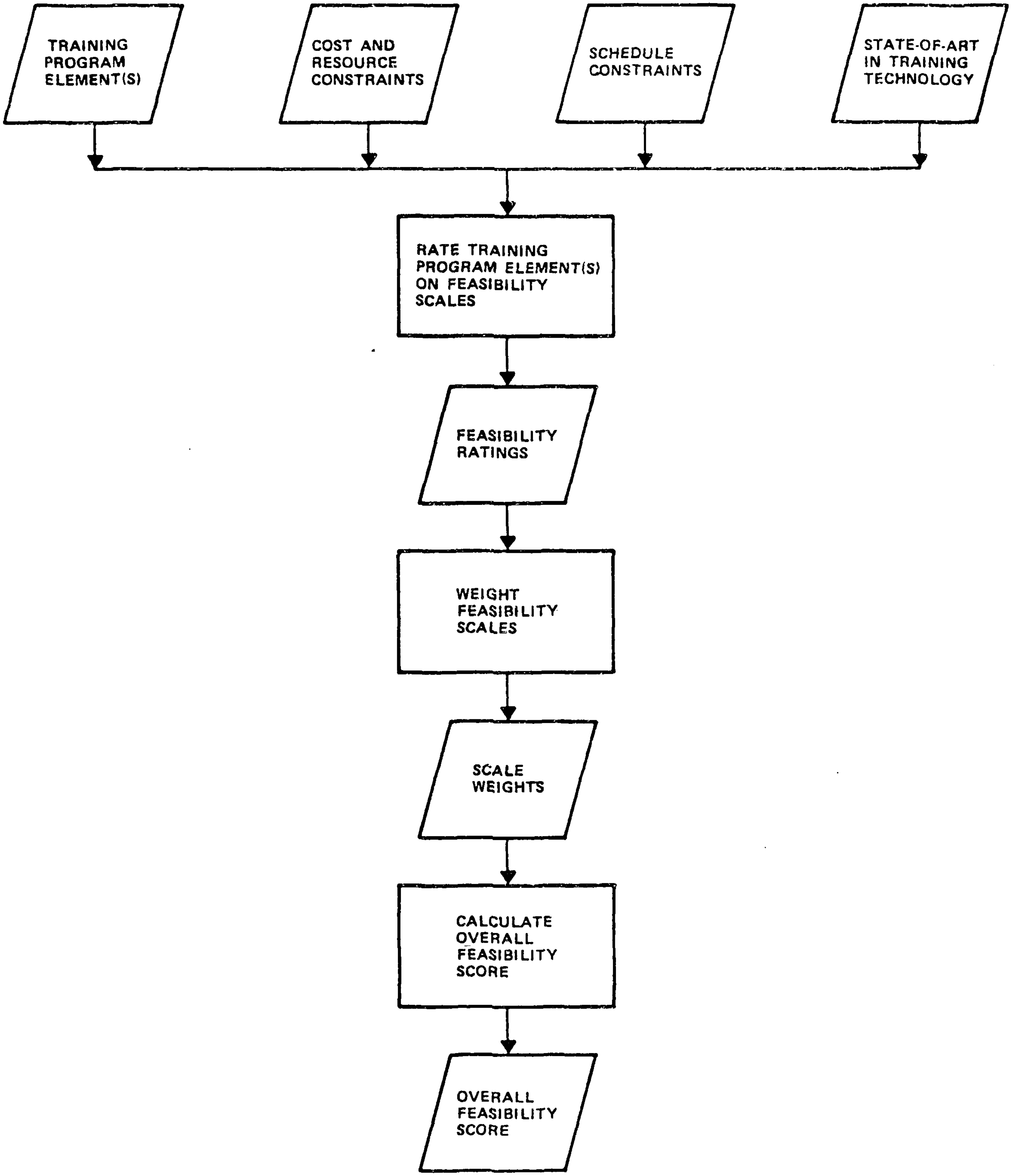

Figure 7-4 Overview Diagram Assess Feasibility of Training Program Elements

Table 7-8. Worksheet for Assessing Feasibility Scales (FEASCAL)

System____________________ Alternative____________________

Course Number____________________ Training Program Element____________________

Course Title____________________ ____________________

Rater____________________ ____________________

	1 Not at all Likely	2 Somewhat Likely	3 Moderately Likely	4 Likely	5 Extremely Likely
Please rate the training program element on the four scales listed below.					
(1) Likelihood that training program element can be developed given the current state-of-the-art in training technology					
(2) Likelihood that training program element can be developed given the existing budget allotted to training development and operation					
(3) Likelihood that training program element can be developed and implemented given the availability of critical training resources (e.g., instructors)					
(4) Likelihood that training program element can be developed in accordance with required system schedule milestones					

Table 7-9. Worksheet for Measuring Feasibility (FEAS).

System________________ Alternative________________

Course Number________________ Training Program Element________________

Course Title________________

(a) Scale	(b) Score	(c) Weighted Score
Technical Feasibility		
Cost Feasibility		
Resource Feasibility		
Schedule Feasibility		

Total

New system on these three figures-of-merit are divided by the Predecessor score on the same figures-of-merit. This converts the figures-of-merit to a common scale. Weights are then assigned to each FOM and the weighted scores are then summed to provide a summary evaluation score.

PROCEDURE

A worksheet which can be used to construct the summary evaluation score is presented in Table 7-10. A separate summary evaluation score can be constructed for each course or training program element. To begin the procedure, the user should enter information on the Predecessor and New system cost, effectiveness, and training complexity (training time) into the appropriate column in the worksheet. Cost values are produced in Procedure 5.1. Training effectiveness scores are produced in Procedure 6.1. Training time is calculated in Procedure 3.5. After these values have been entered the Predecessor cost and training complexity scores should be divided by the New system scores on these two variables. (See Table 7-10). The New system effectiveness score should be divided by the Predecessor system effectiveness score.[1] Weights should be developed for each of the three figures-of-merit. The weights should reflect the user's estimate of the individual importance of these three figures of merit. The weights should dum to 1.0 and should be entered into the appropriate columns in Table 7-10. The user will probably want to use the same weight for each course.

---

[1]The divisions are designed to produce a summary evaluation score where high scores are "good" and low scores are "bad".

Table 7-10. Worksheet for Documenting Summary Evaluation Score (SUMEVAL).

System

Alternative

	COST					EFFECTIVENESS					TRAINING COMPLEXITY					
(a) Course Training Program Element	(b) Predecessor	(c) New	(d) New Predecessor	(e) Weight	(f) Weighted Score	(g) Predecessor	(h) New	(i) New Predecessor	(j) Weight	(k) Weighted Score	(l) Predecessor	(m) New	(n) New Predecessor	(o) Weight	(p) Weighted Score	(q) Summary Score (e)+(k)+(p)

A weighted score fore ach FOM can be obtained by multiplying each of the predecessor/New system ratios by the weight for the FOM. A summary evaluation score is calculated by summing the weighted scores for the three FOMs.

7.2 IDENTIFY LIKELY PROBLEM AREAS

OVERVIEW

During this procedure, training problem areas are identified. A problem area is defined as an MOS with a high score on the three figures-of-merit which provide the most critical diagnostic information on training for New systems. These figures-of-merit are total training cost, effectiveness, and training complexity (training time).

In ETES, problem areas are identified in a two step process. First, all areas where the figure-of-merit for the New system exceed the figures-of-merit for the Predecessor System (that is where the New system does not fall within the footprint of the Predecessor) are considered to be problem areas. These are the areas which should be given primary considerations during tradeoff analyses and identification of training alternatives.

Second, the areas within the New system which have the highest scores on the figures of merit are identified. These areas represent secondary problem areas which should be examined after the primary areas (i.e., the areas where the New system does not fall within the footprint of its predecessor) have been examined.

PROCEDURE

An overview of the steps in this procedure is outlined in Figure 7-5. During the procedure, both primary and secondary problem areas are identified. A primary problem area is the occupational specialty (and associated equipments) where the New system training figures-of-merit exceed the Predecessor system figures-of-merit (i.e, where the New system does not fit within the footprint of the predecessor). Three figures-of-merit are used for this Predecessor-New system comparison: (1) total cost, (2) effectiveness, and (3) training complexity (training time).

Secondary problem areas are identified by rank ordering the MOSs in the New system by their associated figure-of-merit scores. This process identifies the five MOSs, with the highest scores on each of the three figures-of-merit described above.

This procedure begins by collecting the scores on the three figures-of-merit (total cost, effectiveness, and complexity) for all MOSs in the Predecessor and New system. A worksheet for describing this data is presented in Table 7-11. Any MOS where the figure-of-merit scores for New system is 15% greater (or 15% less in the case of cost) than the Predecessor system may be considered to be a primary problem area.

Secondary problem areas are identified by rank/ordering the MOSs within the New system by the three figures-of-merit The MOSs with the five highest lowest in the case of effectiveness scores on each figure-of-merit are identified. Table 7-12 displays a worksheet for conducting this analysis.

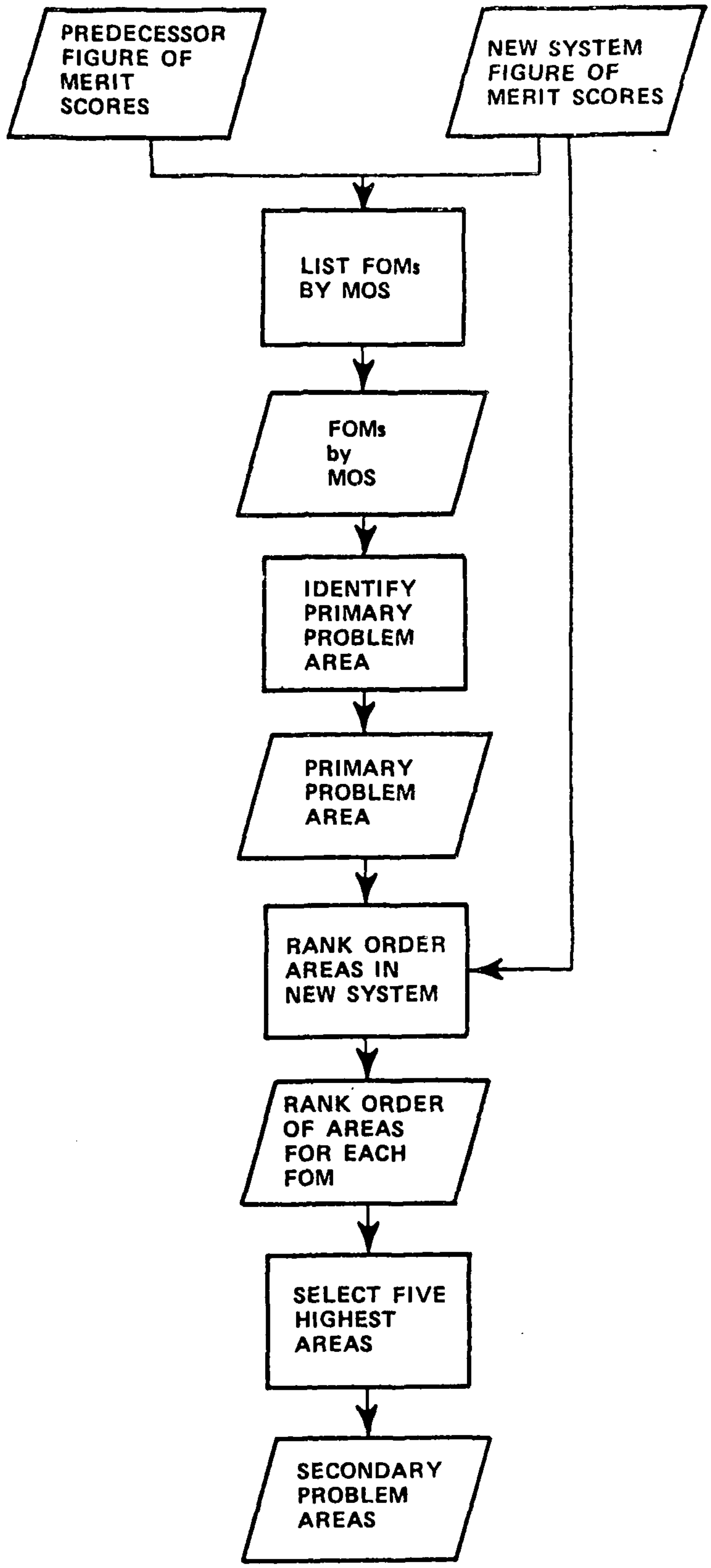

Figure 7-5 Overview Diagram Identifying Problem Areas (7.2)

Table 7-11. Worksheet for Identifying Primary Problem Areas (TRAINPROB).

System______________ Alternative______________

MOS	Associated Equipment	COST			EFFECTIVENESS			TRAINING COMPLEXITY			Primary Problem Area
		Predecessor	New	% Difference	Predecessor	New	% Difference	Predecessor	New	% Difference	

Table 7-12. Worksheet for Identifying Secondary Problem Areas (SEC PROB)

System ____________________ Alternative ____________________

COST	EFFECTIVENESS	TRAINING COMPLEXITY
1		
2		
3		
4		
5		

7.3 IDENTIFY LIKELY CAUSES OF PROBLEM AREAS

OVERVIEW

During Procedure 7.2 problem areas (i.e., MOSs) related to three figures-of-merit (cost, effectiveness, and training complexity) were identified. In order to identify alternatives for ameliorating these problem aresa, the likely causes of the high scores in these three figures of merit must be determined.

Typically, the term "cause" of a training problem is used in two distinct ways (see Figure 7-6).

First, it is used to refer to courses, equipments, and tasks which are associated with the high figure-of-merit scores. In this sense, task x or equipment y can be said to be the cause of the high training figure-of-merit. For instance, one MOS may have an exceedingly high training cost and this high cost can be traced back to the course associated with one particular equipment subsystem.

Second, the term "cause" of training figure-of-merit can be used to refer to the underlying variable which leads to high figure-of-merit scores. For example, the large number of students to be trained can be identified as the "cause" of high training costs.

The first type of casual analysis identifies "where" the problem lies while the second types of casual analysis provides information on the nature of the problem. The second type of casual analysis is more difficult since it

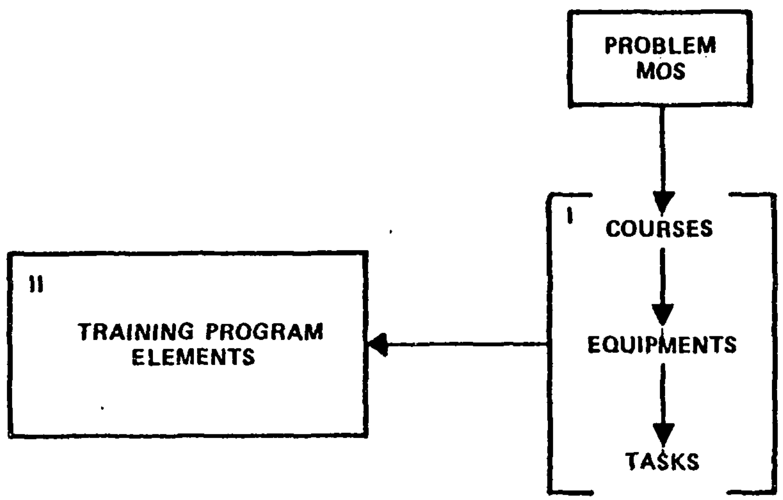

Figure 7-6 Relationship Between Two Types of Causes of Training Problems

requires the identification and examination of complex interrelationships among variables.

The procedure described in this section deals with both types of casual analysis.

PROCEDURE

An overview of the steps in this procedure is provided in Figure 7-7. First, the courses within each problem MOS that are the major contributors to the high figures-of- merit are identified. For cost and training complexity (i.e., course length) this is relatively straightforward since courses are the basic units for aggregating these figures-of-merit. For training effectiveness, which uses task as the basic unit of analysis, this is accomplished by examining the tasks associated with each course.

Following the identification of problem courses, problem equipments (subsystems) are identified by examining the task descriptions associated with each course. These same task descriptions are used to identify the tasks within each course which are the major contributors to high cost, low effectiveness, or high training complexity.

Once the problem tasks have been determined, the casual factors likely to produce the high figures-of-merit are identified. This is accomplished by first examining the casual model underlying each figure-of-merit. These casual models are presented in Figures 7-8, 7-9 and 7-10. To determine likely casual factors, the user should start with the figure-of-merit and move backwards in the casual structure (from right to left in Figures 7-8, 7-9 and 7-10). Examining the values of the variables in the casual structure and noting where "excessively high" values occur. To identify an excessively high score, the user should

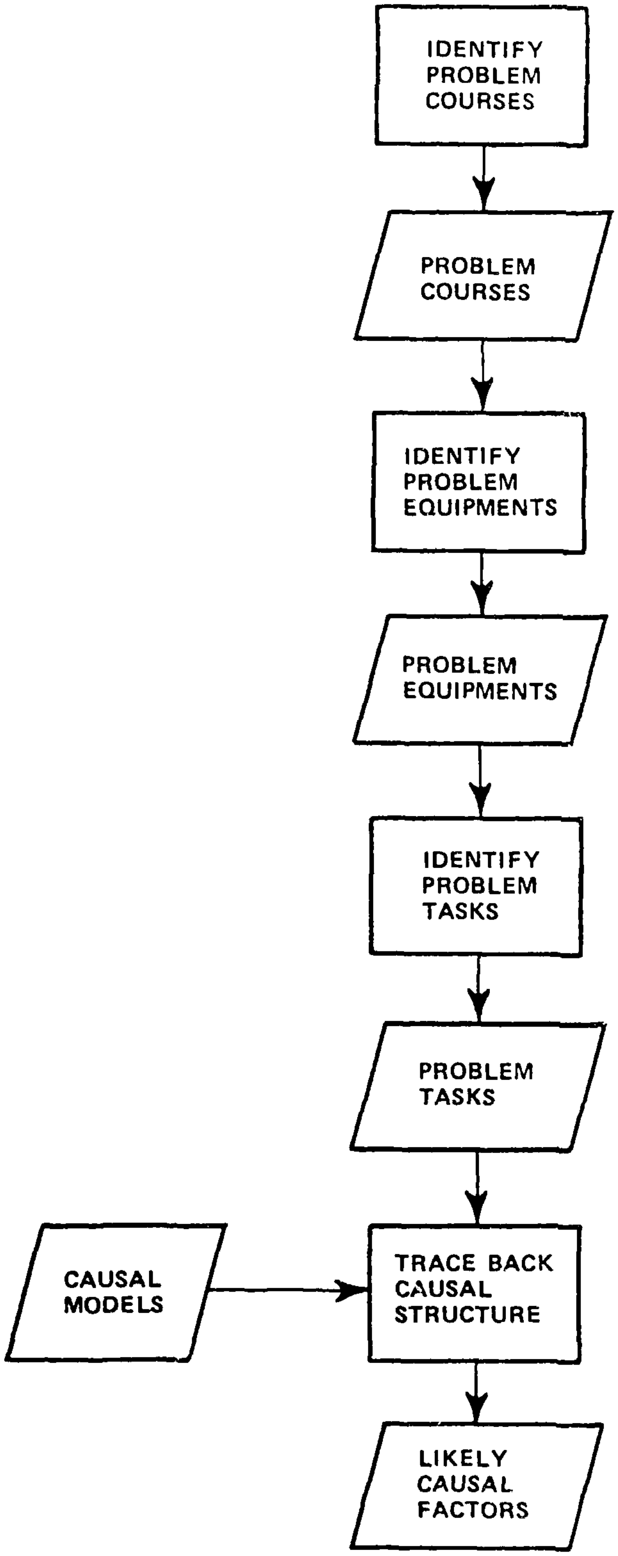

Figure 7-7 Overview Diagram Identifying Likely Causes (7.3)

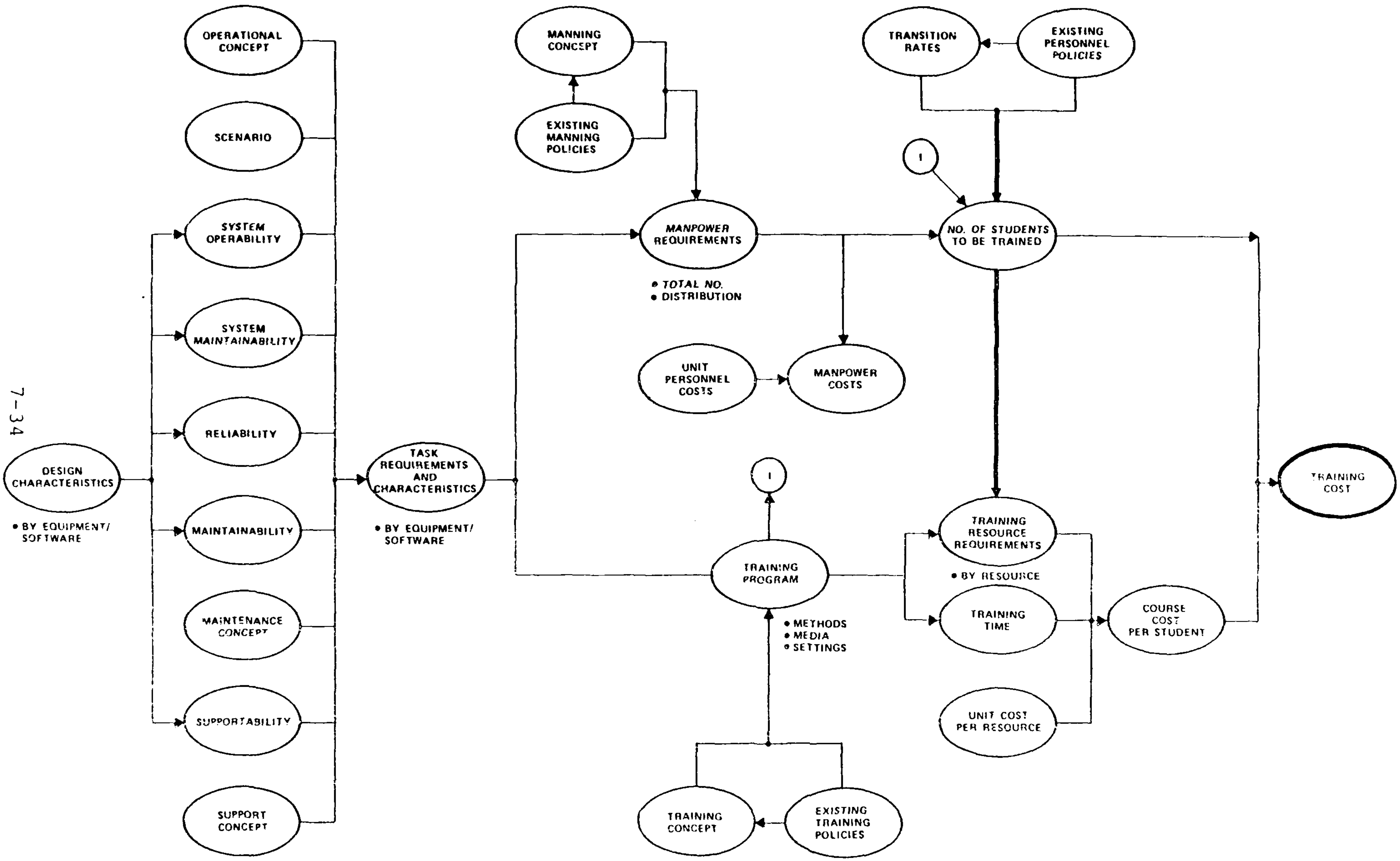

Figure 7-8. Overview of Causal Structure Underlying Training Cost.

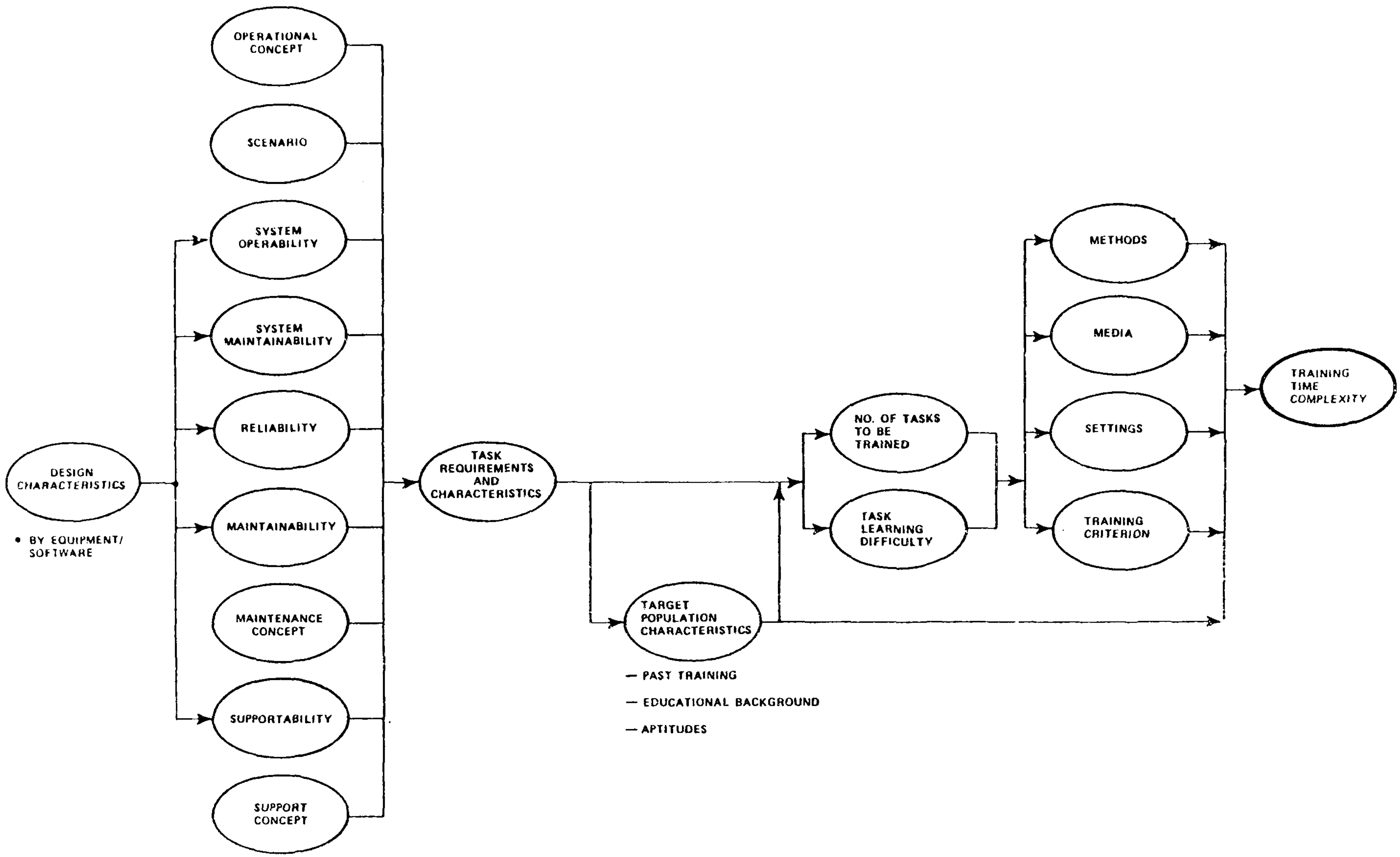

Figure 7-9 Overview Of Causal Structure Underlying Training Complexity (Training Time)

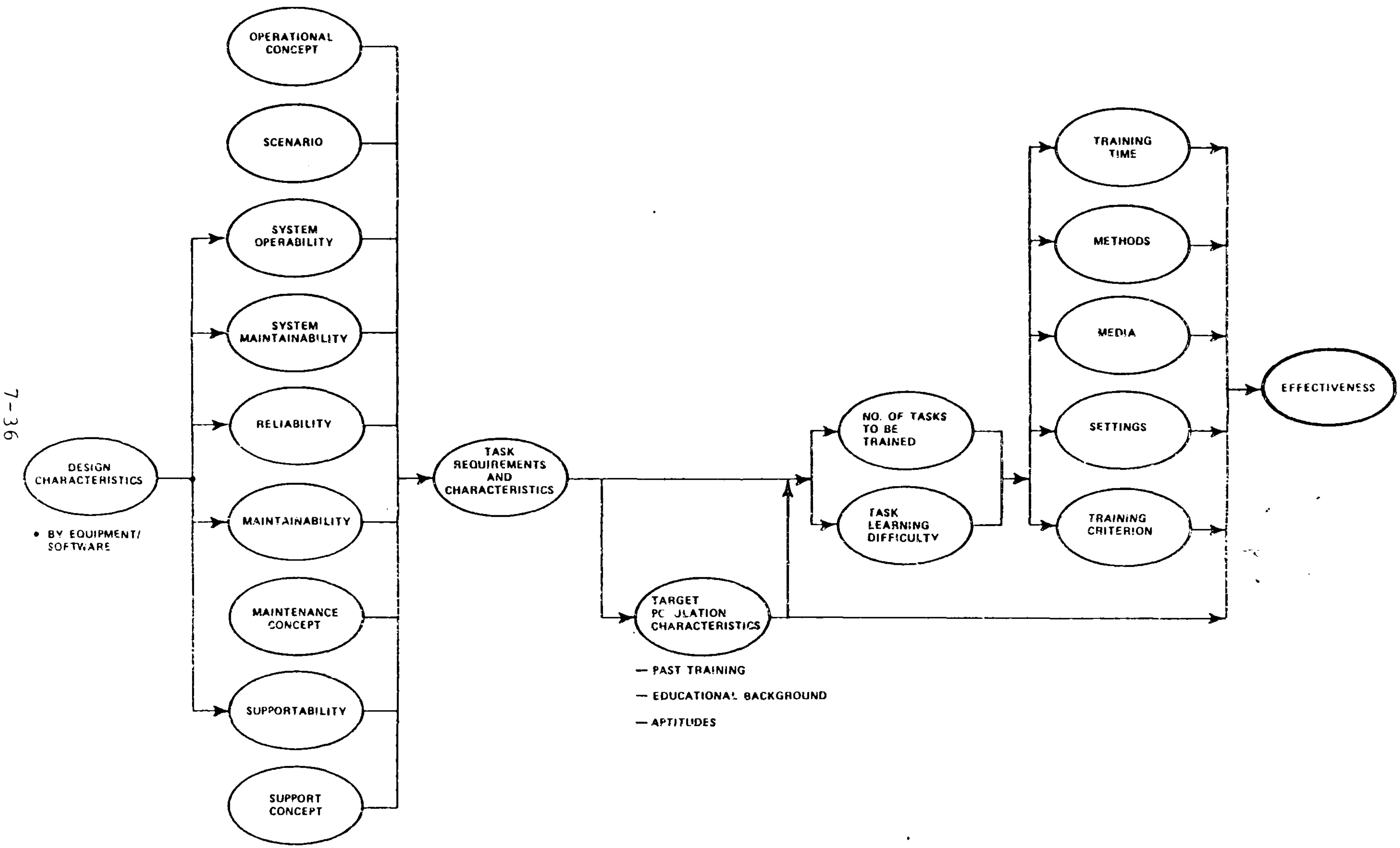

Figure 7-10 Overview Of Causal Structure Underlying Early Measure Of Effectiveness

compare the value of the New system on that variable to the value of the Predecessor (or BCS) system on that variable. A difference of 15% or greater can be considered excessive. Variables with excessively high difference scors which are not preceded in the casual structure by other variables with high difference scores can be considered potential causes of the high figure-of-merit. Alternatives which may reduce the values of these potential causes are identified in Procedure 7.4 A worksheet which can be used to document the identification of causes is presented in Table 7-13.

7.4 IDENTIFY ALTERNATIVES

OVERVIEW

During Procedure 7.2 potential training problem areas were identified. During Procedure 7.3 likely sources of these problems were identified and prioritized. During this Procedure, alternatives for the training-related sources are identified. In addition, non-training related sources of training problems (e.g., hardware/software design) are highlighted and brought to the attention of the Program Management Office.

PROCEDURE

An overview of the procedure for identifying training alternatives is presented in Figure 7-11. First the sources of training problems are sorted into two categories: training-related sources and non-training related sources. Alternatives are not identified for the training related sources since these are beyond the purview of the training analyst. However, the non-training related sources are presented to the program office for review.

Table 7-13. Worksheet for Describing Causes of Training Problems (CAUSE).

System ____________________ Alternative____________________

(a) Problem Area			(b) Related Courses	(c) Related Equipments	(d) Related Tasks	(e) Other Causes
MOS	Equipment	FOM				

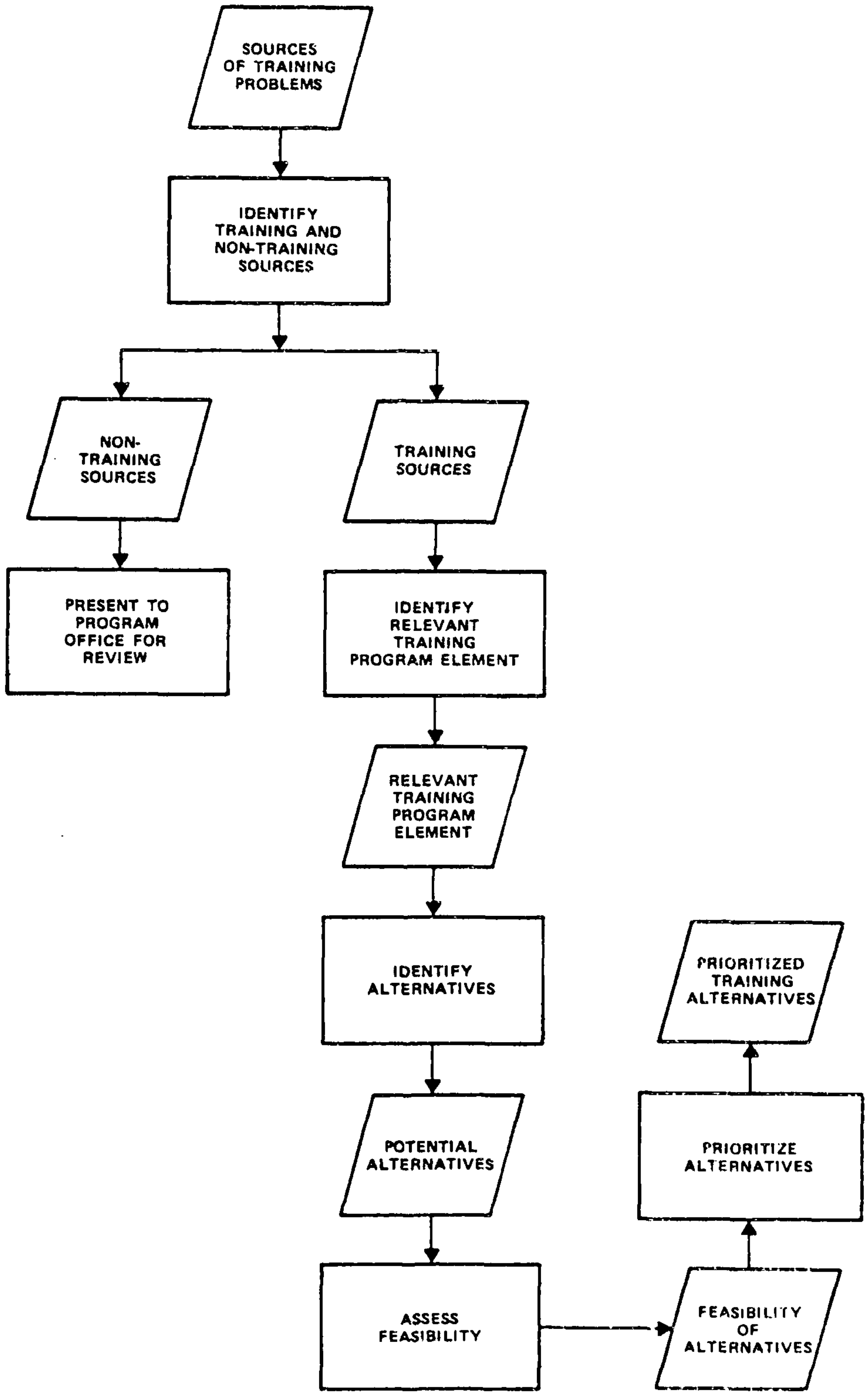

Figure 7-11 Overview Diagram: Identify Alternatives (7.4)

The training-related sources are examined further to identify the relevant training program element associated with the alternative. During the early phases of the acquisition process, nine major categories of training alternatives may be examined (1) settings, (2) methods, (3) media, (4) course sequencing (between courses), (5) scheduling of modules within courses, (6) the amount of time spent in training tasks within a course, (7) course frequency, (8) course location, and (9) usage rates for training resources.

The general alternatives for training settings, methods, and media are well defined. These alternatives are presented in Tables 7-14, 7-15, and 7-16. The user may determine which method or media alternative is likely to reduce the training problem by constructing training efficiency scores for each alternative (see Procedure 6.1).

The alternatives for the other categories of training program element are less well-defined. Users can obtain guidance for selecting alternatives in these areas by examining the procedures that were used to originally create these training program elements. A list of the functions associated with the score categories of training programs elements is provided in Table 7-17. After potential alternatives have been identified, the feasibility of these alternatives must be assessed using the procedures listed under Procedure 7.1.4. Subsequently, the alternatives must be prioritized, taking into account (a) their feasibility, (b) the priority of problem source with which they are associated (as determined in 7.2), and (c) the cost of rerunning the appropriate ETES steps to assess the alternatives in Procedure 7.5. The user must take care to

Table 7-14. Training Setting Alternatives

Institutional Training Settings	Skill Level
Basic Training (BT)	1
Advanced Individual Training (AIT)	1
One Station Unit Training (OSUT)	1
Primary NCO Course (PNCOC)	2
Basic NCO Course (BNCOC)	3
Advanced NCO Course (ANCOC)	4
Senior NCO Course (SNCOC)	5
Primary Technical Training Course (PTC)	2
Basic Technical Training Course (BTC)	3
US Sergeants Major Academy (USASMA)	--
Support School (SPT SCH)	--
Primary Leadership Course (PLC)	2

Unit Training Settings

Supervised On-the-Job Training (SOJT)

Self-Study

Scheduled Training

Training Extension Courses (TEC)

Army Correspondence Course Program (ACCP)

Table 7-15. Training Method Alternatives

AT	Audio Tape
C	Conference/Lecture
CAI	Computer Assisted Instruction
CS	Case Study
D	Demonstration
DF	Dual Flight Hours (only aviator courses) (do not include in ICH computations)
E1	Hardware Performance Examination
E2	Nonhardware Performance Examination
E3	Nonhardware Performance Examination
EL	Elective (in-house only, except for CGSC)
F	Film
GS	Guest Speaker
IS	Independent Study
NC1	Non-contact Instruction with an Instructor Available in Classroom
NC2	Non-contact Instruction without an Instructor Available
PE1	Hardware Oriented (hands-on) Practical Application
PE2	Nonhardware Oriented (non-classroom) Practical Application
PE3	Classroom Practical Application
PI	Programmed Instruction (using programmed text)
PM	Printed Materials
QC	Besseler Cue See
S	Seminar
SF	Solo Flight Hours (only aviator courses) (do not include in ICH computations)
SI	Simulation Instruction
SP	Self-Paced Instruction
ST	Slide Tape
TV	Television
WC1	Instructor Led Work Group
WC2	Student Led Work Group

Sources: DA Pam 570-558 Staffing Guide for U.S. Army Service Schools and TRADOC Cir 351-12 Format for Programs of Instruction

Table 7-16. Training Media Alternatives.

Media Category
Print Instructions w/o Feedback
Print Instructions with Oral Feedback
Print Instruction - with Written Feedback
Print - Reference Material
Image Projection - Still
Passive Audio
Active Audio
Audiovisual - Still with Feedback
Audiovisual - Still without Feedback
Audiovisual - Motion with Feedback
Audiovisual - Motion without Feedback
Static Display without Feedback
Dynamic Display without Feedback
Physiological Trainer - Internal
Physiological Trainer - Audio
Physiological Trainer - Visual
Symbolic Simulation with Feedback
Trainer
Simulator
Operational Equipment
Operational Equipment with Feedback
Visual Computer - Still with Feedback
Visual Computer - Still without Feedback
Visual Computer - Motion with Feedback
Visual Computer - Motion without Feedback
Audiovisual Computer - Still with Feedback
Audiovisual Computer - Still without Feedback
Audiovisual Computer - Motion with Feedback
Audiovisual Computer - Motion without Feedback
Instructor

Table 7-17. Training Project Elements

Training Program Element	Function
Settings	3.2
Methods	3.6
Media	3.6
Course Scheduling (Within course)	3.5
Training Time	3.6
Course Frequency	4.1
Course Location	4.1
Training Resource Usage Rates	4.1

restrict the alternatives to a reasonable number and to those areas where he/she can get the "biggest bang for the buck" since the cost of evaluating alternatives can be expensive. Cost savings can be achieved by combining alternatives into one or two major alternative training programs.

7.5 EVALUATE ALTERNATIVES

OVERVIEW

During this procedure the training alternatives selected for analysis in the previous step are evaluated by reapplying selected ETES procedures and sensitivity analysis are conducted of key parameters.

PROCEDURE

Procedures for evaluating alternatives and conducting sensitivity analyses are presented in the sections which follow.

7.5.1 Evaluate Alternatives

An overview of the procedure for evaluating alternatives presented in Figure 7-12. First, the Training Estimation Aids and Procedures which must be reapplied to assess each alternative must be identified. This is accomplished by examining Table 7-17 which lists the ETES procedures which must be reapplied to reflect changes or alternatives in nine major categories of training program elements.

Once the ETES Procedures which must be reapplied have been

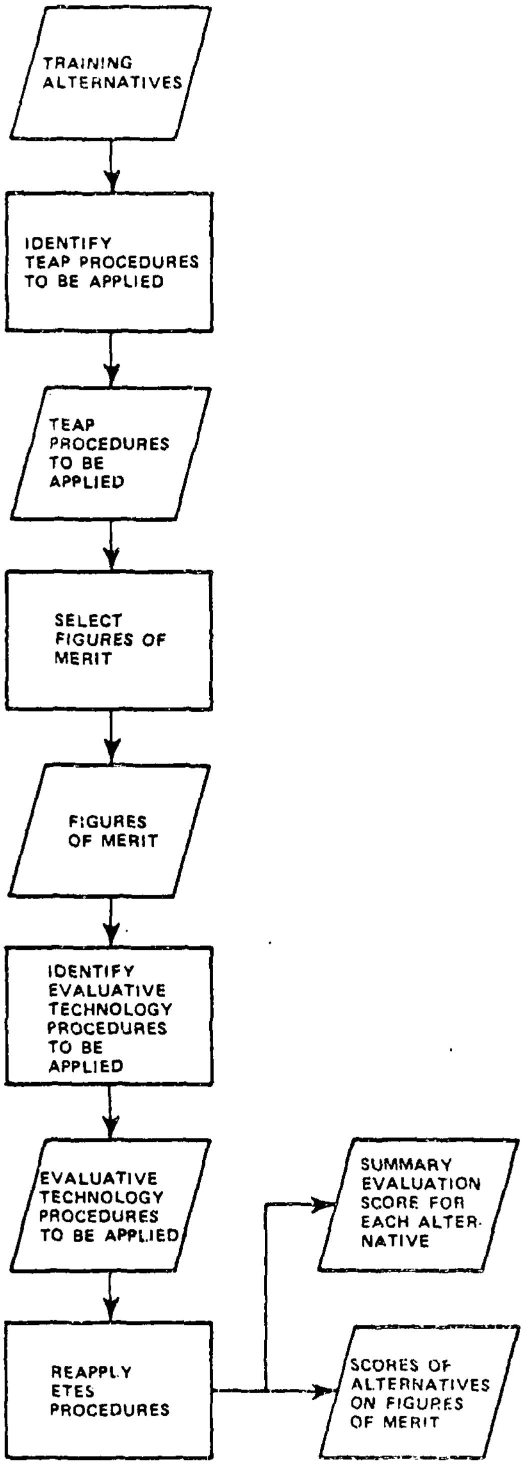

Figure 7-12. Overview Procedure for Evaluating Training Alternatives.

identified, the Evaluative Technology Procedures which must be reapplied are determined. To accomplish this, the figures- of-merit that will be used to evaluate the alternative must be identified.

Once all of the required ETES Procedures have been identified, they must be reapplied. As the steps are applied, the worksheets should be complete to document the results of each reapplication of an ETES procedure.

7.5.2 Conduct Sensitivity Analyses

Sensitivity analyses can be conducted to determine how changes in key variables impact the results of the training requirements analysis. Sensitivity analyses should be conducted for variables for which (a) there is concern about the accuracy of the values assigned to the variables, or (b) there are several strong competing alternatives which may significantly change the value of the variable.

The procedure for conducting sensitivity analysis is outlined in Figure 7-13.

First, the variables on which the sensitivity analyses will be conducted are determined. Sensitivity analyses are typically conducted for two types of variables. First, sensitivity analyses are conducted for variables where there is concern about the accuracy of the values assigned to the variable. For instance, a questionable value has been assigned to a cost element for a course and the user is interested in seeing how changes in this acquisition cost would impact total training cost. Second, sensitivity analyses are conducted for variables for which there are a

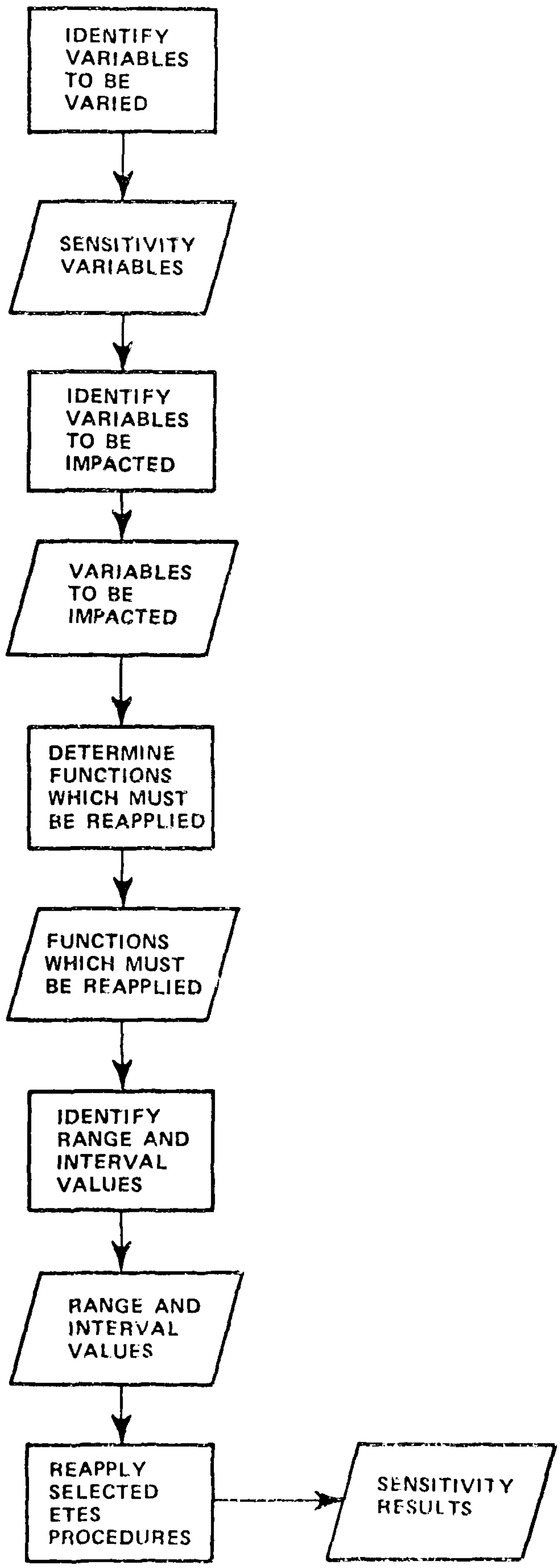

Figure 7-13 Overview Diagram: Conduct Sensitivity Analysis

number of strong alternatives which may change the value of the variables. For instance, if the user believes that the number of students which must be trained could range from 2000 to 3000 and he/she is interested in determining how training resources and costs will be impacted by these variations, then a sensitivity analysis would be conducted on this variable.

Once the sensitivity variables have been identified, the user must identify the variables he/she will use to assess the sensitivity impacts. This is accomplished by examining Table 7-18 which describes the major variables associated with each function in ETES. Additional information is provided in the causal models described under Procedure 7.3. In general, the user may select any variable(s) that are associated with a higher numbered function (that is any variables which occur later in the causal structure underlying training requirements). Most typically, the user will examine the impact of changes in sensitivity variables on the training figures-of-merit. All procedures listed at or between the function associated with the sensitivity variable must be reapplied.

After the functions to be reapplied have been determined, the user must identify the range and interval values to be used during the sensitivity analyses. The range of values must encompass the likely alternatives for that variable.

Once the range has been determined, specific values at equally-spaced intervals within the range must be identified. The intervals between the values should be as large as possible while still capturing the likely alternatives.

Table 7-18. Listing of Candidate Parameters for Sensitivity Analyses

Parameter	ETES Procedure
Task Selection Criteria	3.1 Select Tasks for Training
Task Selection Criteria	3.2 Assign Tasks to Training Settings
Training Times Per Method	3.6 Construct QPOI
Training Times Per Module	3.6 Construct QPOI
Training Times Per Course	3.6 Construct QPOI
Criticality Weights	3.7 Assign Tasks to Media
Utility Weights	3.7 Assign Tasks to Media
Constraint Levels	3.7 Assign Tasks to Media
Student-Instructor Ratios	4.1 Develop Course Operating and Support Plan
Media Usage Rate	4.2 Develop Course Operating and Support Plan
Attrition Rates	4.2 Determine Number of Students to be Trained
Upgrade Rates	4.2 Determine Number of Students to be Trained
Manpower Requirements	4.2 Determine Number of Students to be Trained
Number of Students	4.3 Determine Instructor Requirements
Instructor Contact Hours Per Method	4.3 Determine Instructor Requirements
Course Frequency	4.3 Determine Instructor Requirements
Student/Instructor Ratios	4.3 Determine Instructor Requirements

Table 7-18 (Continued)

Parameter	ETES Procedure
Number of Students	4.4 Determine Facilities Requirements
Facilities Requirements per Student	4.4 Determine Facilities Requirements
Number of Students	4.5 Determine Training Device and Training Equipment Requirements
Instructor Contact Hours	4.5 Determine Training Device and Training Equipment Requirements
Course Length	4.5 Determine Training Device and Training Equipment Requirements
Media Usage Rate	4.5 Determine Training Device and Training Equipment Requirements
Number of Students	4.6 Determine Requirements for Other Training Resources
Number of Students	5.1 Estimate Individual Course Costs
Course Length	5.1 Estimate Individual Course Costs
Number of Instructors	5.1 Estimate Individual Course Costs
Course Frequency	5.1 Estimate Individual Course Costs
Reference/Unit Training Costs	5.1 Estimate Individual Course Costs
Criticality Weights	6.1 Estimate Efficiency

Once the range and values have been determined, the selected ETES functions must be reapplied. Table 7-19 presents a worksheet which can be used to summarize the results of sensitivity analyses.

7.6 EVALUATE IMPACT OF SYSTEM CHANGES

OVERVIEW

As the development of the system progresses there are likely to be changes to non-MPT system elements such as the hardware/software design and manpower requirements. During this subfunction, the impacts of these changes on training are determined.

PROCEDURE

There are two steps in this proced'.res. First, the ETES procedures which must be reapplied in response to system changes must be determined. This is accomplished by examining Table 7-20 which lists the functions which must be reapplied to reflect changes in non-MPT system elements such as the hardware/software design or manpower requirements. Second, the identified procedures must be reapplied. All changes and results should be entered into the ETES audit trail so that a complete record of the system development process is maintained.

Table 7-19. Worksheet for Describing Results of Sensitivity Analyses (SENS).

System____________________
Course Number____________________
Course Title____________________

Alternative____________________
Variable Changed____________________

(a) Variables Impacted	(b) Sensitivity Values					
	______	______	______	______	______	______

Table 7-20. ETES Procedures Which Must Be Reapplied In Response to System Changes

System Variable Changed	ETES Functions Which Must Be Reapplied
Design Concepts	1.6, 2.0 to 8.0
Weapon System Requirements	1.1 to 1.6, 2.0 to 8.0
Organizational & Operational Concepts	1.1 to 1.6, 2.0 to 8.0
System Functions	1.1 to 1.6, 2.0 to 8.0
Mission Profile & Operational Mode Summary	1.1 to 1.6, 2.0 to 8.0
Threat and Scenario	1.2 to 1.6, 2.0 to 8.0
System Acquisition Objectives and Constraints	1.1 to 1.6, 2.0 to 8.0
System Acquisition Schedule	1.1 to 1.6, 3.0 to 8.0
MOS/Duty Position Assignments	2.3, 2.5, 3.0 to 8.0
Skill Level Assignments	2.3, 2.5, 3.0 to 8.0
Manpower Requirements	4.2 to 4.6, 5.0, 6.0, 7.0, 8.0

SECTION 8.0 - DEVELOP INPUTS TO ACQUISITION PROCESS

OVERVIEW

During this procedure, a training development schedule is constructed and ETES-related inputs to Army acquisition processes and documents are specified.

8.1 DEVELOP/MONITOR TRAINING DEVELOPMENT SCHEDULE

Procedures for developing a training-development schedule are provided in the Automated Planning and Scheduling Technique (APST). An overview of APST is provided in Appendix C. A more detailed description of APST is provided in the User's Guide: Automated Planning and Scheduling Technique.

APST can be used to assist training developers in describing and monitoring the training development schedule for developing Army weapon systems. APST is designed to be used with the Visischedule software, which is an automated program for describing, monitoring and reporting schedule information and for conducting critical path analyses of schedule events.

8.2 DEVELOP INPUTS TO ACQUISITION PROCESSES AND DOCUMENTS

OVERVIEW

This procedure describes how the products of the other ETES aids/procedures can be used to support Army acquisition documents and processes.

Table 8-1 lists the documents and processes which have the most relevance to early training estimation.[1]

The two documents/processes which are most critical to early training estimation were (1) the Outline Individual and Collective Training Plan (OICTP) and (2) Cost and Training Effectiveness Analysis (CTEA). More details on the relationships between ETES procedures and the Army acquisition documents processes are provided in the sections 8.2.11. An overview of the relationship between ETES and the Army Life Cycle System Management Model (LCSMM) is provided in Section 8.2.12.

8.2.1 Develop Inputs to OICTP/ICTP

The OICTP and ICTP are plans which support the development and implementation of new or revised individual and collective training programs at institutional and unit levels. The OICTP and ICTP are the major resources and planning documents for developing training for new Army systems. An approved OICTP is sufficient justification to enter manpower and funding requirements into the Army's programming and budgeting processes for inclusion of the TRADOC Review of Manpower (TRM). As specified in existing regulations TRADOC Reg. 351-9), the OICTP/ICTP contains a proposed training concept and training strategy. The concept and strategy are typically generated by the proponent school responsible for the New system's training requirements.

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1 Overviews of the Army acquisition process are provided in DA Pam 11-25 and in Wagner (1982).

Table 8-1 LCSMM DOCUMENTS AND PROCESSES RELATED TO EARLY TRAINING ESTIMATION

DOCUMENTS/PROCESS	IMPLICATIONS FOR EARLY TRAINING ESTIMATION
Outline Individual and Collective Training Plan (OICTP/ICTP) (see TRADOC Reg 351-9)	The OICTP/ICTP is the Major Resource and Planning Document for Training. It Contains Summary and Schedule Information on all Major Training Product Areas.
Cost and Training Effectiveness Analysis (CTEA) (see TRADOC Training Effectiveness Analysis Handbook, TRADOC Reg 350-4)	The CTEA is Potentially the Most Critical Document Related to Early Training Estimation. A CTEA Requires Users to Identify and Evaluate Training Alternatives. Currently, However, CTEAs are Seldom, if ever, Conducted Prior to Milestone I.
Logistic Support Analysis (LSA) (see AR 700-127, DARCOM-P-750-16, MIL-STD-1388)	Process for Identifying Integrated Logistics Support (ILS) Elements. Training is one of these Elements. Currently, however, LSA is Seldom if ever, Conducted Prior to Milestone I.
Operational Testing (OT) (see AR 1000-1, AR 700-126, AR 702-9, AR 70-1, AR 70-10 and AR 71-3)	A Comprehensive Early Training Estimation System could Assist in the Identification of Training-Related Test Issues for Operational Testing (OT-1).
Training Device Letter of Agreement (TDLOA)/ Training Device Requirement (TDR) (see TRADOC Cir 70-10, Training Device Requirements Guide)	The TDLOA and TDR are Requirements Documents which Initiate the Development of New Training Devices. ETES Facilitates Early Initiation of these Documents.
New Equipment Training Plan (NETP) (see AR 350-35)	The NETP is the Primary Planning Document for New Equipment Training, the Interim Training Required to Introduce the New System into the Army Inventory. ETES Facilitates the Development of a More Accurate and Earlier NETP.
Justification for Major New System Start (JSMNS) and Letter of Agreement (LOA) (see DoD 5000.2, and AR 71-9)	The JSMNS and LOA are the Primary Requirements Documents for New Systems. These Documents often Contain General Statements of the System Training Requirements or Training Concept. ETES Facilitates Development of this Information.

Table 8-1 (Continued..)

DOCUMENTS/PROCESS	IMPLICATIONS FOR EARLY TRAINING ESTIMATION
Tentative Quantitative and Qualitative Personnel Requirements Information (TQQPRI) and Integrated Personnel Summary (IPS) (see AR 71-2 and TRADOC Reg 600-4)	The TQQPRI and IPS are Key Documents in Describing Personnel Requirements for the New System. ETES Supplies Task and Skill Information which Facilitates the Identification of MOS and Skill Levels which are Critical Parts of these Documents.
Request for Proposal (RFP)/Proposal Evaluation	ETES Provides Input for the Identification of Training Requirements for Inclusion in the Weapon System RFP and Could Provide a Baseline from Which to Evaluate Contractor Responses to the RFP.
Tradeoff Determination (TOD), Bets Technical Approach (BTA), Concept Formulation Package (CFP), Decision Coordinating Paper (DCP), Defense System Acquisition Review Council (DSARC), Army System Acquisition Review Council (ASARC). (see AR 71-9, AR 70-27, AR 1000-1, AR 15-14, and TRADOC Reg 11-8)	The TOD, BTA, CFP, DCP, DSARC Review and ASARC Review are all High Level Documents Concerned with Overall System Evaluation. Training Related Input ot these Documents are Provided through the Training Planning Process (OICTP/ICTP/NETP), CTEA Analysis and LSA Analysis.
Mission Area Analysis (MAA) (see TRADOC Handbook on Mission Area Analysis)	Mission Area Analysis is the Ongoing Evaluation of Current Capabilities in a Functional Area. MAA occurs Prior to Milestone 0. ETES Provides a Capability for Evaluating the Training-Related Implication of the Alternatives which are Generated During MAA.

The OICTP/ICTP is an evolving document that increases in specificity (via appropriate updates) as the system under development is further defined. The OICTP/ICTP provides significant feeder data for the Tentative Qualitative and Quantitative Personnel Requirements Information (TQQPRI), the Training Effectiveness Analysis (TEA), and the New Equipment Training Plan (NETP). After LOA approval, the OICTP can be used by the contractor to facilitate the identification of training requirements conducted as part of the logistic support analysis.

The OICTP/ICTP is intended to guide the development of training subsystem requirements and to provide the general framework for their incorporation into the existing training base. The regulations specifically emphasize the intention to use the proposed training concept in the OICTP/ICTP to "...identify the constraints which training requirements and resources may impose on the design of the materiel system" (TRADOC Reg 351-9, pg. 5). The regulation also mandates use of the OICTP/ICTP as the vehicle to describe "... the integration of the training subsystem into the development of the total system and the integration of the developing system into ongoing training systems."

TRADOC Reg 351-9 further stipulates that the OICTP/ICTP must incorporate the principles of Army Training 1990 (AT 90) into training for a new system, for both institutional and unit training and at all skill levels for the MOSs affected. The OICTP/ICTP is intended to develop and describe a systematic and feasible strategy for training, ranging from the development of "initial qualification" training to the "sustainment of the proficiencies" needed for the successful fielding and operational deployment of the system being acquired.

As specified in existing regulations, the OICTP/ICTP provides information on the training required to integrate replacements from the training base into the unit, and to qualify personnel for higher level tasks as they advance in grade. The OICTP/ICTP is further directed to provide information on the identification, quantification, and need for training devices, simulator, documentation/publications, training aids, support facilities, instructors, costs, and all other support and logistic considerations necessary for the implementation and test of the proposed training plan.

Table 8-2 provides an overview of the elements in the OICTP/ICTP and describes which ETES procedures can provide input to the development of these elements.

The TRADOC Training Effectiveness Analysis Handbook produced by TRANSANA specifies the elements which must be included in an institutional training concept that is part of the OICTP. Most information elements which are required in the institutional training concept can be produced by applying ETES procedures.

Table 8-3 lists the information elements of the institutional concept and describe which ETES procedure can be used to produce these elements. A more detailed description of information elements in the training concept is provided in Appendix H. This description is taken directly from the TRADOC Training Effectiveness Analysis Handbook.

8.2.2 Develop Inputs to Cost and Training Effectiveness Analysis (CTEA)

The CTEA process is potentially the most critical LCSMM process related to early training estimation since it

Table 8-2. Relationship Between OCITP and ETES Functions.

ELEMENTS IN OICTP[1]	RELATED ETES PROCEDURES/AIDS: PROCEDURE/AID	RELATED ETES PROCEDURES/AIDS: RELATIONSHIP
• System Description	1.0 Conduct Functional Reqs Analysis	ETES provides procedures for estimating system functional and system hardware/software design concepts during earliest phases of the acquisition process.
• System Milestones	8.1 Develop/Monitor Training Development Schedule	ETES automated planning and scheduling technique (APST) lists major system milestones related to training development.
• Training Development Schedule	8.1 Develop/Monitor Training Development Schedule	ETES automated planning and scheduling technique (APST) provides automated tool for describing and updating training development schedule.
• Descriptions of Training Products	-	-
- SPA/TM	NC	-
- SM/TG	NC	-
- SQT	NC	-
- ARTEP	NC	-
- Resident Training Program	3.0 Estimate Training Program	ETES contains procedures for estimating training program during earliest phases of WSAP
- Resident Training Equipment	4.5 Determine Training Device and Equipment Reqs.	ETES contains general guidelines for estimating requirements.
- Training Devices	4.5 Determine Training Device and Equipment Reqs.	ETES contains general guidelines for estimating requirements.
- Training Literature	NC	-
- TEC	NC	-
- Audiovisual	NC	-
- ACCP	NC	-
- Facilities/Ranges	4.4 Determine Facilities Reqs.	ETES contains general guidelines for estimating requirements.
- Ammunition	4.6 Determine Reqs. for other training resources	ETES contains general guidelines for estimating requirements.

[1] Source - TRADOC Reg. 351-9
NC - Not Covered in ETES

Table 8-2 (continued)

ELEMENTS IN OICTP	RELATED ETES PROCEDURES/AIDS		
	PROCEDURE/AID		RELATIONSHIP
- Net	8.7	Develop Inputs to Acquisition Process	ETES contain general procedures for modifying early training program concepts for use in new equipment training.
• Training Resources	4.0	Estimate Training Resources	ETES contains procedures for developing early estimates of resource requirements for resident training courses.

Table 8-3. Relationship Between Institutional Training Concept Elements and ETES Procedures.

TRAINING CONCEPT ELEMENT[1]		ETES PROCEDURE
1.0	Courses Impacted	3.6
1.1	Modification or New Course	3.6
1.2	Changes to Current Courses	3.6
2.0	Student Load per Class per Year	4.2
2.1	Average Grade of Student	---
2.2	Student Source	3.4
3.0	Class Frequency Per Year	4.1
3.1	Length of Class	3.6
3.2	Fiscal Year of Course Start	4.1
4.0	Instructor Reqs. Per Course	4.3
5.0	Support Personnel Requirements	4.2
6.0	Expended Equipment Per Class	4.6 (partially)
7.0	Non-Expended Equipment Per Class	4.5
8.0	Exportable Training Used*	Not Covered in Current ETES
8.1	Exportable Software*	Not Covered in Current ETES
8.2	Training Terms	3.6
8.3	Exportable Hardware*	Not Covered in Current ETES
9.0	Facility Requirements	4.4

* These elements refer to institutional training elements sent to units in the field.

[1] As specified in TRADOC Training Effectiveness Analysis Handbook.

requires the user to not only estimate what the training program will look like (as does the OICTP/ICTP), but also to evaluate these training programs and to provide training-related input into the overall system development and evaluation process.

The new TRADOC Reg 351-9, governing the OICTP process, contains the most current definition of the CTEA. It defines CTEA as " a methodology which involves documented investigation of the comparative effectiveness and costs of alternative training systems for attaining defined performance objectives." The definition further specifies that a CTEA can focus on any one or a combination of the following:

- o Training concepts
- o Training strategies
- o Training equipment/devices
- o Programs of instruction
- o Training impacts of
  - New materiel
  - Organization
  - Tactics
  - Employment techniques
  - Families of systems

Regardless of the specific focus of the CTEA, TRADOC Regulation 351-9 stipulates that the CTEA should include an analysis of the attainable levels of proficiency and the costs associated with each alternative. In addition, a CTEA should include a cost effectiveness trade-off analysis of the feasible alternatives. This regulation further specifies that a CTEA must:

- Insure that training development is initiated early in the life cycle of hardware systems and is accomplished in coordination with combat developments,

- Optimize soldier-hardware subsystem interface,

- Insure that all feasible training subsystem alternatives are considered,

- Optimize soldier-training subsystem interface,

- Recommend the preferred training alternative based on cost and training effectiveness, and

- Provide decision makers with more precise information at critical points in the acquisition process concerning the total system (comprising the training, hardware, and other subsystems).

These objectives demonstrate that the CTEA, unlike the OICTP and the QQPRI/BOIP, is an early training-related document intended, in theory at least, to influence the hardware system design. This is a very significant difference from the OICTP, which is, by regulation, primarily an MPT planning and resource document.

The steps in the CTEA process and the corresponding ETES procedures which can provide input to this process are listed in Table 8-4.

Table 8-4. Relationship Between CTEA and ETES Functions

STEPS IN THE CTEA PROCESS[1]	RELATED ETES PROCEDURES/AIDS: PROCEDURES/AIDS	RELATED ETES PROCEDURES/AIDS: RELATIONSHIP
• Analyze Hardware	1.0 Conduct Functional Requirements Analysis	These ETES procedures can be used to estimate system functional requirements and system hardware/software design concepts during earliest phases of the acquisition process.
• Determine Tasks to Operate Hardware	2.0 Generate Tasks	These procedures can be used to generate tasks during the earliest phases of the acquisition process.
• Develop Soldier Profile	3.3 Identify Target Population	ETES provides procedures for estimating tasks and skills. With this data as input, target population descriptions can be operated through existing procedures in the job and task analysis handbook.
• Determine Soldier Capabilities	NC	-
• Analyze Soldier-Hardware Subsystem Interface	7.2 Identify Problem Areas	ETES provides general guidelines for identifying equipments associated with negative training impacts (relative to baseline system)
• Design Alternative Training Subsystems	3.0 Estimate Training Program 7.4 Identify Alternatives	ETES provides procedures for generating an early training concept and general guidelines for identifying training alternatives. Current ETES only deals with institutional training.
• Estimate Cost	5.0 Determine Training Cost	ETES provides procedures for estimating training costs for institutional training courses
• Estimate Effectiveness	6.0 Estimate Training Efficiency/Effectiveness	ETES provides procedures for estimating training efficiency and for developing a crude measure of training effectiveness that can be used early in the WSAP
• Update CTEA Based on DT/OT Results	NC	-
• Participate in DT/OT I Testing Cycle	8.2 Develop Inputs to Acquisition Processes and Documents	ETES provides critical input data to HRTES which can be used to develop test issues for OT
• Select Best Conceptual Training Alternatives for Further Development	7.5 Evaluate Alternatives	ETES provides procedures for evaluating early training concepts and alternatives.
• Modify Training Alternatives Based on Hardware System Development	7.6 Assess Impact of System Changes	ETES provides general procedures for rerunning the training estimation process in response to system change
• Prepare More Detailed Cost Effectiveness Estimate	NC	-
• Develop Training Concept (Institutional Training Course) 1	-	-

[1] Source, TEA Handbook

NC = Not Covered in ETES

Table 8-4 (continued)

STEPS IN THE CTEA PROCESS[1]	RELATED ETES PROCEDURES/AIDS	
	PROCEDURES/AIDS	RELATIONSHIP
- Courses Impacted	3.6 Construct Quasi-POI	Covered fully in ETES procedure
- Course Description	3.6 Construct Quasi-POI	Covered fully in ETES procedure
- Changes to Current Courses	3.6 Construct Quasi-POI	Covered fully in ETES procedure
- Student Load per Year	4.2 Determine No. of Students to be Trained	Covered fully in ETES procedure
- Average Grade per Student	NC	-
- Student Source	3.3 Identify Target Population Description	Covered fully in ETES procedure
- Class Frequency	4.1 Construct Operating and Support plan	Covered fully in ETES procedure
- Class Length	3.6 Construct Quasi-POI	Covered fully in ETES procedure
- Start Year	4.1 Construct Quasi-POI	Covered fully in ETES procedure
- Instructor Requirements	4.3 Identify Instructor Requirements	Covered fully in ETES procedure
- Support Personnel Requirements	4.3 Identify Support Personnel Requirements	ETES procedure provides general guidelines and algorithms for Determining Requirements
- Expended Equipment Per Class	4.6 Estimate Other Resources	ETES procedure provides general guidelines and algorithms for Determining Requirements
- Non-expended Equipment Per Class	4.5 Determine Training Device and Train Equip. Requirements	ETES procedure provides general guidelines and algorithms for Determining Requirements
- Expendable Training	NC	-
- Expendable Software	NC	-
- Training Teams	NC	-
- Expendable Hardware	NC	-
- Facility Requirements	4.4 Determine Facilities Reqs.	ETES procedure provides general guidelines and algorithms for determining requirements.
• Prepare/Submit Reports	NC	-

[1] Source, TEA Handbook

8.2.3 Develop Inputs to Logistic Support Analysis

As defined in AR 700-127, Logistics Support Analysis (LSA) is the use of analytical tools and models to (1) develop and evaluate alternative support concepts, (2) project manpower and personnel impacts, (3) perform tradeoffs between system design and ILS elements and tradeoffs among ILS elements, integrated support planning and design, and (5) measure life cycle impact of materiel and support system alternatives. The outputs of LSA are used to (a) influence materiel design or selection, (b) develop the required logistic support system, (c) provide the manpower and logistics analysis for the intergrated program summary, and (d) record the LSA during the materiel acquisition phase to compare it with operational use.

Training is one of the Integrated Logistics Support (ILS) elements. Hence, all of the analyses requirements required by the LSA apply to training.

One of the key components of LSA is the Logistics Support Analysis Record (LSAR). The LSAR sheets provide a formal mechanism for describing the support elements of a developing system. As such, LSAR sheets, like the ETES SDT, can be reviewed as a tool for describing developing support concepts. Table 8-5 describes the LSAR elements which are included in the SDT and the ETES procedures in which these elements are generated.

8.2.4 Develop Input to Operational Testing

As defined in DA Pam 11-25, operational testing is the testing and evaluation of materiel systems which is

Table 8-5. LSAR Elements Included in ETES SDT.

LSAR Sheet	LSAR Element	Related ETES Procedure
A	FGC/WBS/WUC Equipment Item Name MFG Part Number	1.6
A	Annual Operating Requirements Measurement Base Annual Number of Missions Annual Operating Days Mean Mission Duration	1.1
A	Number Supported MTTR, MTBF, MTBMA	1.4, 1.5
B	Maintenance Tasks	2.2, 2.4
	Maintenance Task Times	Optional
	Skill Level, Skill Codes	2.3, 2.5
C	Maintenance Operator Tasks	2.2, 2.4
D	Training Material Description	3.7, 4.5, 4.6
F	Facility Description	4.4
G	Duty Positions–Task Relationships	
	Skill Requirements	3.3

accomplished with typical user operators, crews, or units in as realistic an operational environment as possible to provide data to estimate the military utility, operational effectiveness, and operational suitability (including compatability, interoperabiltiy, safety, reliability, availability, and maintainability, supportability, operational man (soldier)-machine interface and training requirements) of new systems. Training is, and should be, one of the key elements considered during OT. The Army Research Institute has developed a procedure called HRTES (Human Resource Test and Evaluation System) which is specifically designed to provide human factors and training-related input to OT testing.

An overview of the functions performed in HRTES is presented in Figure 8-1.

Table 8-6 displays the relationships between ETES functions and HRTES functions. The HRTES system index assists analysts in identifying comparable existing systems which may be used to identify system mission functions. Systems mission functions are then identified and documented in a mission chart. The term "mission" in HRTES is equivalent to the concept of function described in ETES Function 1.0. Once the missions (i.e., functions) have been identified, system performance measures for these functions are identified. HRTES also contains procedures for evaluating the results of operational testing.

The HRTES procedures for identifying OT training issues (Human Performance Functions, Human Performance Measures, Test Conditions, Human Resource Issues and Measures) can be used to identify OT test requirements within the total ETES

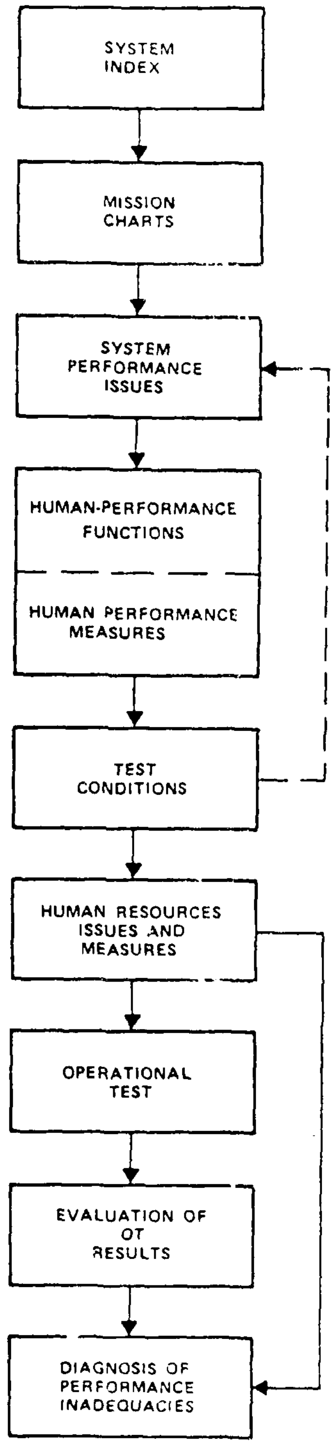

Figure 8-1. Basic HRTES Flow.

Table 8-6. Relationships Between HRTES Function and ETES Function.

HRTES Function	ETES Function
System Index	1.4 Establish Baseline Comparison System
Mission Charts	1.1 Identify Required System Functions
System Performance Issues	1.2 Identify System Performance Measures and Goals
Human Performance Functions	2.4 Develop New System Task List
Human Performance Measures	--
Test Conditions	--
Human Resources Issues and Measures	--
Operational Test	--
Evaluation of OT Results	--
Diagnosis of Performance Inadequacies	--

framework. Direct input for these procedures is provided by the system functions (missions in HRTES terminology) and performance measures identified in Function 1.0. An overview of HRTES procedures for identifying OT test items and issues is provided in Appendix I.

8.2.5 Develop Inputs to Training Device Requirements, Documents and Processes

A Training Device Requirement (TDR) is a document which states concisely the minimum operational, technical, logistical, and cost information necessary for development of a training device. A TDR is required if the funding thresholds exceed $2 million in RDTE funds and/or $3 million for any fiscal year or more than S15 million for the 5 year program in procurement funds.

Training device requirements which are not covered by TDRs are specified in the Training Device Letter Requirement (TDLR).

The Training Device Letter of Agreement is a jointly prepared and authenticated document in which the combat/training developer (TRADOC) and the materiel developer outline the basic agreements for further investigation of a potential training device system.

During ETES Procedure 3.7, general requirements for training devices are identified. More specifically, the tasks which are most likely to require training via devices are identified. This information provides the essential input data needed to initiate a Training Development Study (TDS). A TDS is a cost and training effectiveness analysis

conducted to support the development of training devices. (See TRADOC Reg 351-9 for a description of TDS procedures). In addition, the resource requirements estimates (e.g., number of students to be trained) made during Procedure 4.0, provide input to the estimation of cost and resource requirements for the training device. The TRAINVICE methodology described in Procedure 6.1 and in Appendix G provides a mechanism for calculating the training "efficiency" of an emerging training device concept.

8.2.6 Develop Inputs to New Equipment Training

New Equipment Training (NET) provides for the initial transfer of knowledge from contractor and/or materiel developer to tester/user that is needed for operator maintenance and logistic support during testing and initial introduction of new materiel into the Army.

In the past, training developers have often produced initial resident training courses by modifying the NET courses, many of which were developed in an unsystematic fashion. Using the ETES procedures, a different concept of course development can be employed. More specifically, using ETES procedures, an early description of the system training program (that is, the training program that will be used when the system is fielded) can be developed <u>first</u>. Task differences and target population differences between the NET courses and the system training program can then be identified using the procedures described in Procedures 2.0 and 3.4. NET courses can be generated using Procedure 3.6 (Construct Quasi-Program of Instruction). Resource and cost estimates can then be generated usin the Procedures 4.0 (Estimate Training Resources) and 5.0 (Estimate Training

Costs). This strategy has an obvious advantage in that it starts with the end objective (system training program) and then identifies the intermediate products (NET courses) needed to meet those objectives.

8.2.7 Develop Inputs to System Requirements Documents

The Justification for Major System New Start (JMSNS) is used to identify and support the need for a new or an improved mission capability. The JMSNS is required only for justifying the initation of a new major acquisition ($75 million or more RDTE or $300 million or more in acquisition costs). If an ETES analyses is conducted during mission area analysis, it will be possible to develop an initial training concept which may be included in the JMSNS.

The LOA is a requirement document jointly prepared by the combat developer and materiel developer which outlines the agreements for further investigation of a potential materiel system during the demonstration and validation phase.

Table 8-7 summarizes the relationships between ETES products and the LOA.

8.2.8 Develop Inputs to Request for Proposal (RFP) Development/Proposal Evaluation

There are four ways in which ETES related products can be used to assist in the development and/or evaluation of the proposals which are generated for system development. First, the results of ETES can be used to specify the minimally acceptable criteria which the training program which is developed by the contractor must meet. This

Table 8-7. ETES–LOA Relationships.

LOA Elements	ETES [illegible]edures Providing Input to Generation of LOA Element
Need for System	1.1 Identify required system functions 1.2 Identify system performance measures and goals 1.3 Allocate required system functions and identify lower level functions
System Concept	1.4 Establish Baseline Comparison System 1.5 Identify required system improvements/new technologies 1.6 Format new system description
Estimated System Effectiveness	Not covered in ETES
Upper Limit on Unit Cost	Not covered in ETES
Technical Concept Investigations Needed	Not covered in ETES
Logistics Support Concept Needed	7.2 Identify likely problem areas 7.4 Identify alternatives
Unknowns to be Resolved	Not covered in ETES
Technical Risks	Not covered in ETES
Schedules and Milestones	8.1 Develop/Monitor training development schedules
Critical Issues for Test	8.2 Develop inputs to acquisition processes and documents (ETES provides input to HRTES)
Advanced Development Funds	Not covered in ETES

criteria can be included in the Request For Proposal (RFP) which is generated for the system.

Second, the ETES Evaluative Technology (Procedure 7.2) can be used to identify likely training problem areas which must be addressed in detail by the contractor. Third, the Baseline Comparison System (BCS) and New System training programs generated by ETES provide a standard with which to evaluate the training programs generated by contractors. For example, if the length of a contractor generated course is significantly less than the length of an ETES generated course, the training developer may want to examine the contractor course in more detail to determine if the contractor is underestimating training requirements to make their design concept look less training intensive.

Fourth, if the user is going to apply ETES or some portion of ETES and wants the contractor to supply the input data needed to feed the ETES procedures, ETES input data requirements must be included in the RFP. Correspondingly, if the user wants the contractor to apply ETES procedures, ETES output requirements (at the procedural step level) must be included in the RFP. If the latter approach is taken, the user must insure that ETES input data from existing Army data bases is included in the government furnished information (GFI) specified in the RFP.

8.2.9 Develop Inputs to Personnel Documents/Processes

The Qualitative and Quantitative Personnel Requirements Information (QQPRI) describes the personnel skills required to operate and support a specific materiel system; their recommended placement within the current, revised, or new

Army Military Occupational Specialties (MOS), including a listing of duties and tasks; new or revised training requirements, and projected annual manpower requirements. Table 8-8 displays the relationship between the elements of the QQPRI and ETES procedures.

According to TRADOC Reg 600-4, Integrated Personnel Support (IPS) is the process by which personnel considerations are integrated into the development effort for a materiel system. Accomplishment of the IPS requires that each personnel consideration be evaluated in terms of its impact on the total personnel support requirements and system design. A goal of this evaluation is a quantitative/ qualitative statement of personnel requirements which will insure the development of the personnel support necessary to achieve the desired operational capability of the materiel. The goals of the IPS roughly parallel the goals of the Cost and Training Effectiveness Analysis (CTEA) which is conducted to assess training. However, the IPS has a strong emphasis on personnel planning and in this sense has objectives similar to the Outline Individual and Collective Training Plan (OICTP). Table 8-9 lists the key IPS products which are generated during the first two phases of the acquisition process and the relationships between these products and the ETES procedures.

8.2.10 Develop Inputs to System Level Documents and Processes

The Concept Formulation Package (CFP) documents the studies conducted during the exploration of alternative systems concepts conducted during the first phase of the acquisition. The CFP consists of four elements:

Table 8-8. ETES–QQPRI Relationships.

QQPRI Elements	ETES Procedures Providing Input to Generation of QQPRI Element
Requirements Document	Not covered in ETES
Equipment Description	1.4 Establish BCS 1.6 Format new system description
Maintenance Manhours	Not covered in ETES
Operator Manpower Requirements	Not covered in ETES
Duty Positions, MOS, Skill Level	2.3 Assign BCS tasks to MOS, duty position and skill level 2.4 Assign new system tasks to MOS, duty position and skill level
Duties and Tasks	2.2 Develop BCS task list 2.4 Develop new system task list
Training Plan	8.1 Develop/monitor training development schedule

Table 8-9. ETES—IPS Relationships.

IPS Elements	Acquisition Phase	ETES Procedures Providing Input to Generation of IPS Element
Individual Skills Required	Concept Exploration	2.2 Develop BCS task list 2.4 Develop new system task list 3.3 Identify skills and knowledges
Estimate of Number of Operators and Maintainers Required	Concept Exploration	Not covered in ETES
Unique Physical and Mental Considerations	Concept Exploration	3.4 Develop target population description
Impact on Morale	Concept Exploration	Not covered in ETES
Duties and Tasks	Demonstration and Validation	2.2 Develop BCS task list 2.4 Develop new system task list
Skills	Demonstration and Validation	3.3 Identify skills and knowledges
Performance Standards	Demonstration and Validation	2.2 Develop BCS task list 2.4 Develop new system task list
Manpower Authorization Factors	Demonstration and Validation	Not covered in ETES
Selection Criteria	Demonstration and Validation	3.4 Develop target population description
Training	Demonstration and Validation	3.0 Estimated training program

(1) Cost and Operational Effectiveness Analysis (COEA) provides essential information on the cost and effectiveness of materiel system alternatives to permit evaluation and decision on the courses of action open for acquisition. The CTEA is one of the key components of the COEA.

(2) Tradeoff Determinations (TOD) describe the apparent technical feasibility of a potential system, including technical risks associated with each approach, estimated RDTE, and procurement costs.

(3) Tradeoff Analyses (TOA) determine what technical approach offered in the TOD is best.

(4) Best Technical Approach consolidates the results of the TOD and TOA.

The CFP is included in the Decision Coordinating Paper (DCP) which is a management summary document to support the Army System Acquisition Review Council (ASARC) and the Defense System Acquisition Review Council (DSARC). ASARC/DSARC reviews are major management reviews conducted prior to entry into successive phases of the materiel acquisition process. DSARCs are for major systems requiring Secretary of Defense approval. ASARCs are for major systems requiring Secretary of the Army approval.

ETES does not provide direct input to the high level acquisition documents/processes described above. However, ETES does provide input to the CTEA (see Section 8.2.1) which is in turn included in the CFP and higher level documents.

8.2.11 Develop Inputs to Mission Area Analysis/Soldier Analysis

Mission Area Analysis (MAA) is the continuing analyses of mission areas which is conducted to identify those mission elements for which existing or projected capability is deficient and to identify opportunities to enhance the capability to achieve and sustain combat operations through more effective and less costly methods and systems. As part of MAA, new system concepts may be identified. ETES provides a mechanism for evaluating the training requirements of these early concepts.

Soldier Analysis provides the initial mechanism for consideration of soldier factors in the MAA. It requires MAA proponents to identify, prioritize, and evaluate soldier factors early in the development of a solution to a deficiency and provides a timely and quantified basis for further studies to evaluate the effects of soldier factors upon solution effectiveness. Table 8-10 lists the products which are generated by Soldier Analysis and the ETES procedures which can provide input to the generation of these products.

8.2.12 Relationship Between ETES and LCSMM

Figure 8-2 describes the LCSMM events which are directly related to ETES. ETES inputs to the LCSMM events are described in Sections 8.2.1 to 8.2.1.1.

Table 8-10. ETES–Soldier Analysis Relationships.

Soldier Analysis Product	ETES Procedures Providing Input to Generation of Soldier Analysis Product
Task Performance Times	Not covered in ETES
Crew/Team Size	Not covered in ETES
CMF/MOS	2.3 Assign BCS tasks to MOS, duty position, and skill level 2.5 Assign new tasks to MOS, duty position, and skill level
Task Difficulty	3.1 Select tasks for training
Skill Levels	2.3 Assign BCS tasks to MOS, duty position, and skill levels 2.5 Assign new tasks to MOS, duty position, and skill level
Training Times	3.6 Construct Quasi-Program of Instruction
Manhours	Not covered in ETES
CMF/MOS Impact	Not covered in ETES
Soldier Supply/Demand	Not covered in ETES

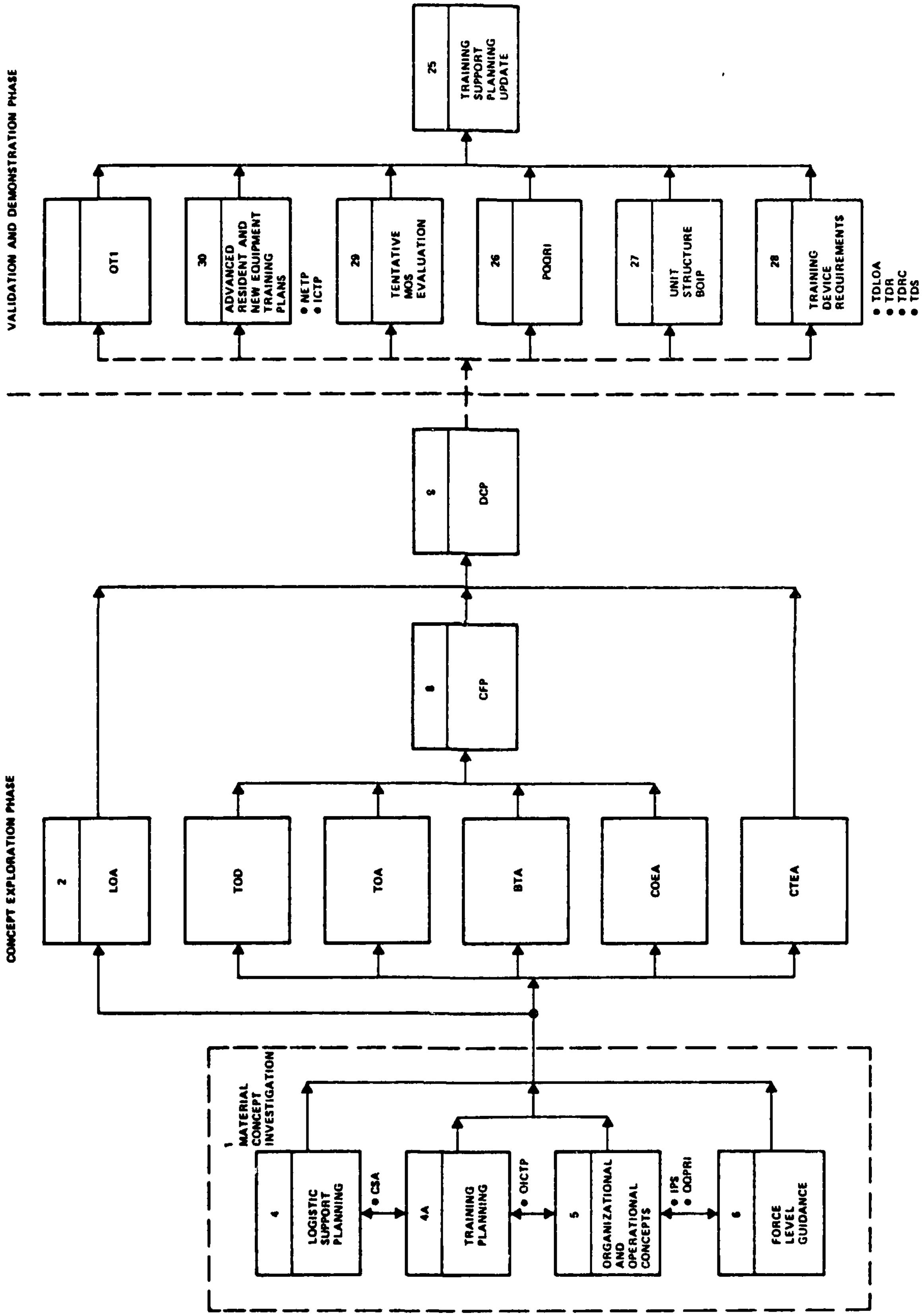

Figure 8-2 LCSMM Events

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ARMY REGULATION	TITLE
1-1	Planning, Programming, and Budgeting within the Department of the Army (MAY 76)
10-4	Organization and Functions, United States Training and Doctrine Command
10-38	United States Army Concepts Analysis Agency (CAA)
11-18	The Cost Analysis Program (DEC 75)
15-14	Systems Acquisition Review Council Procedures (MAY 78)
70-1	Army Research, Development and Acquisition (FEB 77)
70-8	Personnel Performance and Training Program (PPTP) (OCT 78)
70-10	Test and Evaluation During Development and Acquisition of Materiel (JAN 76)
70-15	Product Improvement of Materiel (AUG 80)
70-27	Outline Development Plan/Development Plan/ Army Program Memorandum/Defense Program Memorandum/Decision Coordinating Paper (MAR 75)
71-1	Army Combat Developments (SEP 68)
71-2	Basis of Issue Plan (JUN 76)
71-3	User Testing
71-5	Introduction of New or Modified Systems/ Equipment
71-6	Type Classification/Reclassification of Army Materiel

REFERENCES (continued)

ARMY REGULATION	TITLE
71-7	Military Training Aids and Army Training Aids (OCT 73)
71-9	Materiel Objectives and Requirements (APR 75)
71-11	Total Army Analysis (MAY 80)
310-1	Publications, Blank Forms, and Printing Management
310-3	Preparation, Coordination, and Approval of Department of the Army Publications
310-34	Equipment Authorization Policies and Criteria, and Common Tables of Allowances
310-49	The Army Authorization Documents Systems (TAADS)
350-1	Army Training (JUL 78)
350-35	New Equipment Training and Introduction (NOV 81)
351-1	Individual Military Education and Training (MAR 81)
351-183	Service School Training Reports Control Symbol (JULY 76)
570-2	Organization and Equipment Authorization Tables - Personnel (SEPT 78)
600-200	Enlisted Personnel Management System (FEB 81)
602-1	Human Factors Engineering Program (JUN 76)
611-1	Military Occupational Classification Structure Development and Implementation (JUN 76)

REFERENCES (continued)

ARMY REGULATION	TITLE
611-201	Enlisted Career Management Fields and Military Occupational Specialties (JUNE 82)
700-5	Total Logistics Readiness/Sustainability Analysis (TLR/S) (MAY 78)
700-35	Product Improvement of Materiel
700-78	Production and Post-Production Testing of Army Materiel
700-90	Army Industrial Preparedness Program
700-127	Integrated Logistic Support (ILS) (APR 81)
702-3	Army Materiel Reliability, Availability and Maintainability (RAM) (JAN 77)
715-6	Proposal Evaluation and Source Selection (SEP 70)
725-1	Special Authorization and Procedures for Issues, Sales, and Loans
750-1	Army Material Maintenance Concepts and Policies (JUN 72)
750-4	The Army Materiel Plan-Part II Depot Materiel Maintenance and Support Activities
1000-1	Basic Policies for Systems Acquisition (JUN 81)

TRADOC REGULATION	TITLE
11-1	Manpower Analysis and Force Structuring in Combat Development Forces (OCT 78)
11-5	Cost Analysis Program (MOS Training Costs) (NOV 77)
11-7	Operational Concepts and Army Doctrine (DEC 80)

REFERENCES (continued)

TRADOC REGULATION	TITLE
11-8	Combat Development Studies (FEB 81)
71-4	TRADOC Standard Scen ios for Combat Developments (MAR 77
71-5	Scenario Oriented Re rring Evaluation System (SCORES) (MA
71-10	Integration of the TOE development Process and the Scenario Oriented Recurring Evaluation System (SEP 77)
71-12	Total System Management - TRADOC System Manager (SEP 78)
310-2	Development, Preparation and Management of Army Training and Evaluation Program (ARTEP) (DEC 79)
350-2	Development, Implementation and Evaluation of Individual Training (FEB 79)
350-4	The TRADOC Training Effectiveness Analysis (TEA) System (June 79)
350-7	A Systems Approach to Training
351-4	Job and Task Analysis (MAR 79)
351-9	Individual and Collective Training Plan for Developing Systems: Policy and Procedures
600-4	Integrated Personnel Support (IPS) (JUN 78)
700-1	Integrated Logistic Support (ILS) (JUL 77)

TRADOC HANDBOOK	TITLE
	Mission Area Analysis (DEC 79) (Draft)
	Training Device Requirements Documents Guide (MARCH 79)
	Soldier Analysis (JULY 81)
	TRADOC Training Effectiveness Analysis Handbook

TRADOC PAMPHLET	TITLE
11-8	Cost and Operational Effectiveness Analysis Handbook
71-8	Analyzing Training Effectiveness (FEB 76)
310-8	Collective Front-End Analysis (CFEA) for Development of Army Training and Evaluation Program (ARTEP) (Draft)
350-30	Interservice Procedures for Instructional Systems Development (ISD) (AUG 75)
351-4	Job and Task Analysis Handbook
70-1	Training Device Development (FEB 79) (Expired FEB 80)
350-2	Officer Job/Task Analysis and Training Development (MAR 79) (Expired MAR 80)
350-3	Individual/Collective Training and Development Glossary (Dec 79) (Expired DEC 80)
351-1	Common Job and Task Management (JAN 80) (Expired JAN 81)
351-3	Training Requirements Analysis System (TRAS)/Individual Training Plan (ITP) (DEC 79) (Expired Dec 80)
351-7	Job Training Program (JTP) (APR 80)
351-8	Individual and Collective Training Plan for Developing Systems - Policy and Procedures (MAY 80)

REFERENCES (continued)

TRADOC CIRCULAR	TITLE
351-12	Format for Programs of Instruction (POI) (Expired APR 81)
351-28	Soldier's Manuals, Commanders Manuals and Job Books: Policy and Procedures (Expired Dec 79)

DARCOM/TRADOC PAMPHLETS	TITLE
PAM 70-2	DARCOM/TRADOC Materiel Acquisition Handbook (JAN 80)

DARCOM CIRCULAR	TITLE
700-4	Logistics-Tailoring Procedures Guide (FEB 80)

DA PAMPHLETS	TITLE
11-25	Life Cycle System Management Model for Army Systems (May, 1975)
570-558	Staffing Guide for US Army Service Schools (DEC 79)

MILITARY STANDARDS	TITLE
MIL-STD XYZ	Task Analysis (JAN 80) (Proposed)
MIL-STD 1388A	Weapon System and Equipment Support Analysis (Nov 81) (Proposed)

DEPARTMENT OF DEFENSE DIRECTIVES	TITLE
DODD 5000.1 (Draft)	Major System Acquisitions (DEC 81)
DODD 5000.1	Major System Acquisitions (MAR 82)
DODD 5000.2	Major System Acquisition Procedures (MAR 80)
DODD 5000.39	Acquisition and Management of Integrated Logistic Support for Systems and Equipment (JAN 80)

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DA USASC & FG PAMPHLETS	TITLE
US ARMY SIGNAL CENTER FT. GORDON	Skill Performance Aids (SPA) Management Plan (FEB 79)

UNDERSECRETARY OF DEFENSE MEMO	TITLE
USD (R&E) Memo	Major Defense System Acquisition Program Documentation Format (APR 82)

DEPARTEMENT OF DEFENSE	TITLE
SYSTEMS MANAGEMENT COLLEGE	DOD Acquistion Improvement Program (OCT 81)

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Appendix A: Overview of Media Selection Program

This appendix provides a brief overview of the Media Selection Program. A more detailed description is provided in the User's Guide: Media Selection Program. The Media Selection Program is an automated tool for (1) assigning tasks to media and (2) calculating the efficiency and effectiveness of various task-media combinations. The Media Selection Program allows users to assign tasks to media in a manner that maximizes overall efficiency, maximizes overall "effectiveness," or minimizes overall cost.[1] In addition, it allows users to assign tasks to media in a manner that optimizes various combinations of these variables, including an overall "utility" measure which combi..es either cost and efficiency or cost and effectiveness.

Efficiency, in the Media Selection Program, is determined by comparing the stimulus, response, and feedback characteristic of the tasks to the stimulus, response, and feedback characteristics of potential media. More specifically, a score is calculated which describes the match between media and tasks on these characteristics. Efficiency for each task-media combination is calculated by dividing this score by the maximum match that may be

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1 The program uses a relative cost and not actual cost to measure the potential cost requirements of media. In addition, the program does not use a measure of "effectiveness" that fits the most common usage of that terms. Rather effectiveness is actually efficiency weighted by task criticality.

achieved for the task. Total efficiency for a set of tasks is the sum of the efficiency score for individual tasks.[2]

"Effectiveness" is calculated by weighting the efficiency of each task by a task criticality score. The task criticality score is a user-defined weighted combination of the eight task factors typically used in selecting tasks for training. These eight factors are task frequency, percent members performing, percent time performing, task delay tolerance, consequences of inadequate performance, task learning difficulty, probability of deficient performance, and time between entry and performance.

A matrix of relative cost values is stored in the program for each major media category. In addition, a built-in set of algorithms is used to produce the utility measure which combines cost with either effectiveness or efficiency.

PROCEDURAL OVERVIEW

The Media Selection Program is an interactive menu-driven system. This means that users do not have to know or use a computer language to run the program. Instead, they can run through the program by selecting options from a series of menus.

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2 This concept of media efficiency was originally developed by Jorgensen (1978) and was incorporated into Training Efficiency Estimation Model (TEEM) described in Jorgensen, Kubula, and Atlas (1981).

An overview of the procedures for using the Media Selection Program is provided in Figure A-1. To begin the procedures, users must rate each task on (1) the psychological variables to be used to assess the match between tasks and media, and (2) the variables to be used to assess task criticality (the latter is only necessary if effectiveness is being calculated). These scores must be then entered into the ETES data base management system, the System Description Technology. When this is completed, users must enter the Applications Program mode in the System Description Technology, and select the Media Selection Program. Once in the Media Selection Program, users must then select criteria to be used in making media assignments. Seven options for selecting criteria are provided: (1) efficiency, (2) "effectiveness" (3) relative cost, (4) cost and efficiency, (5) cost and "effectiveness," (6) a utility measure, combining efficiency and cost, and (7) a utility measure combining "effectiveness" and cost.

Once the criteria have been selected, users must select the tasks to be included in the analysis (only tasks already in the SDT may be selected). Typically, the tasks for single course module will be selected for each analysis. With the analysis criteria identified, the psychological variables to be used in calculating the match between tasks and media must be selected. Users may select from 12 variables assessing stimuls characteristics, six variables assessing response characteristics and four variables assessing feedback characteristics.[3]

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[3] These psychological variables were taken directly from the TEEM Model (Jorgeson, Kubula, and Atlas; 1981)

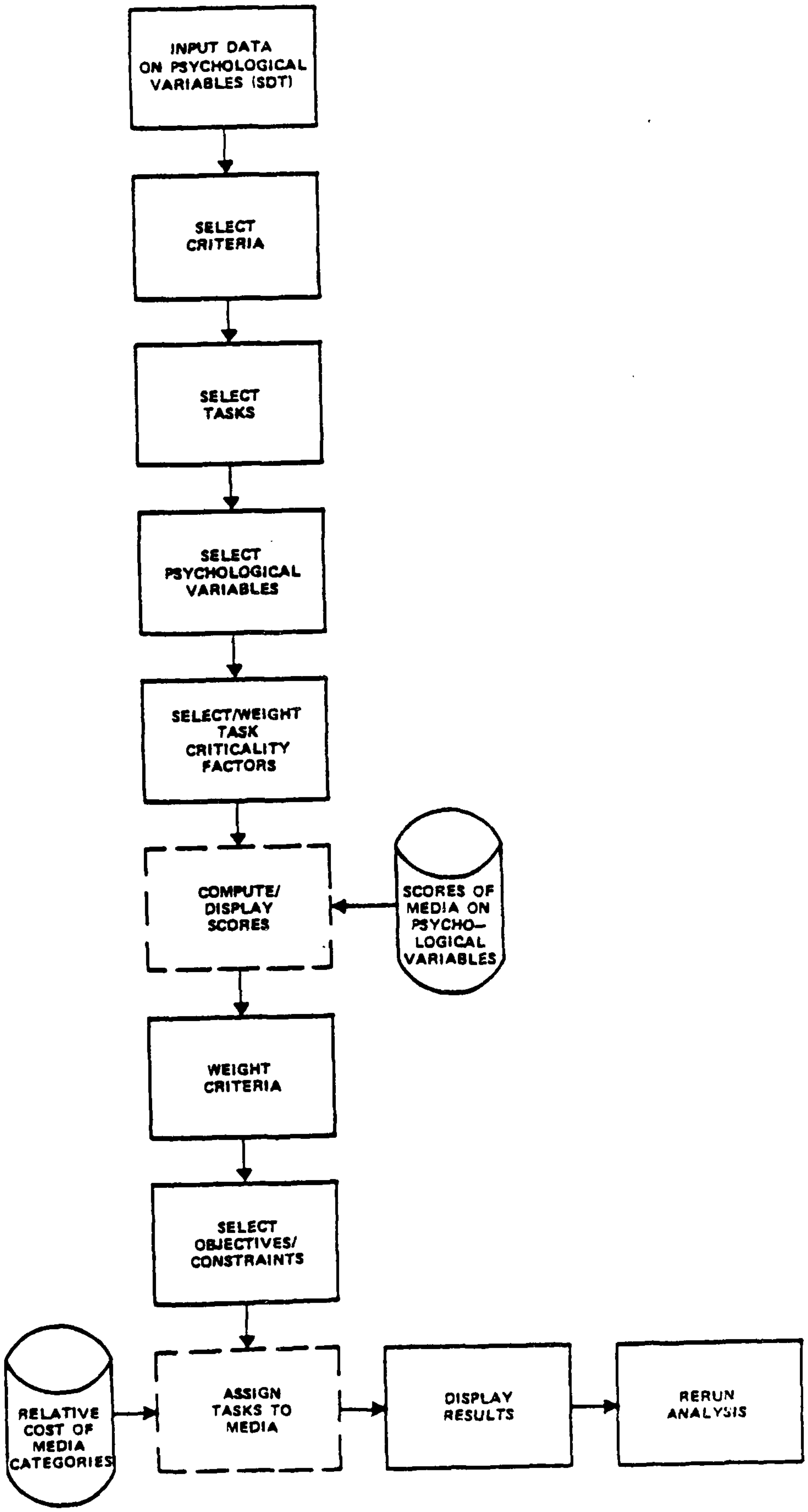

Figure A-1 Overview of Media Selection Program

If the user has selected a set of criteria involving effectiveness (effectiveness, cost and effectiveness, or utility with effectiveness), the weights for the component criticality variables must be entered so that a composite task criticality score can be computed. Eight variables may be used in the calculation of task criticality: (task frequency, percent member performing, percent time performing, task delay tolerance, consequences of inadequate performance, task learning difficulty, probability of deficient performance and time between entry and performance).

At this point, the program has all of the information needed to calculate efficiency and/or effectiveness. It will use this information to calculate the relevant measure and it will display the results.

If the user has selected one of the two utility measures (combining either cost and efficiency or cost and effectiveness) the user will then be required to enter the weights to be used in the computation of utility. Following this, the user must select the objectives and constraints to be used in assigning tasks to media. A listing of the possible combinations of objectives and constraints is displayed in Table A-1. Once this information has been put into the computer, the program will optimally assign the tasks to training media. For instance, if the user selected "maximum effectiveness" as an objective and "minimize cost" as a constraint, the program would determine the assignment of tasks to media which gives the highest overall score on effectiveness and still remains under a user-specified level of overall cost. Once the initial assignments have been examined, the user can examine the effects of several

Table A-1 Possible Assignment Strategies.

OBJECTIVE	CONSTRAINT	ASSIGNMENT STRATEGY	Efficiency	Effectiveness	Efficiency and Cost	Effectiveness and Cost	"Utility" with Efficiency	"Utility" with Effectiveness	Cost	
maximize efficiency	No constraint	Each task is assigned the medium with the greatest efficiency for that task.	X	X	X	X	X	X	X	*
	effectiveness	An assignment of all tasks to media is generated such that total efficiency is maximized and total effectiveness is greater than or equal to user-specified level of effectiveness.		X		X		X		
	"utility"	An assignment of all tasks to media is generated such that total effectiveness is maximized and total "utility" is greater than or equal to a user-specified level of "utility."					X	X		
	cost	An assignment of all tasks to media is generated such that total efficiency is maximized and total cost is less than or equal to a user-specified level of cost.			X	X	X	X		*
maximize effectiveness	no constraint	Each task is assigned the medium with the greatest effectiveness for that task.		X		X		X		*
	efficiency	An assignment of all tasks to media is generated such that total effectiveness is maximized and total efficiency is greater than or equal to a user-specified level of efficiency.		X		X		X		
	"utility"	An assignment of all tasks to media is generated such that total effectiveness is maximized and total "utility" is greater than or equal to a user-specified level of "utility."						X		
	cost	An assignment of all tasks to media is generated such that total effectiveness is maximized and total cost is less than or equal to a user-specified level of cost.				X		X		*
maximize "utility"	no constraint	Each task is assigned the medium with the greatest "utility" for that task.					X	X		*
	efficiency	An assignment of all tasks to media is generated such that total "utility" is maximized and total efficiency is greater than or equal to a user-specified level of efficiency.					X	X		
	effectiveness	An assignment of all tasks to media is generated such that total "utility" is maximized and total effectiveness is greater than or equal to a user-specified level of efficiency.						X		
	cost	An assignment of all tasks to media is generated such that total "utility" is maximized and total cost is less than or equal to a user-specified level of efficiency.					X	X		

Table A-1 Possible Assignment Strategies. (continued)

OBJECTIVE	CONSTRAINT	ASSIGNMENT STRATEGY	CRITERIA: Efficiency	Effectiveness	Efficiency and Cost	Effectiveness and Cost	"Utility" with Efficiency	"Utility" with Effectiveness	Cost	
minimize cost	no constraint	Each task is assigned the medium with the least relative cost.			X	X	X	X	X	*
	efficiency	An assignment of all tasks to media is generated such that total cost is minimized and total efficiency is greater than or equal to a user-specified level of efficiency.			X	X	X	X		*
	effectiveness	An assignment of all tasks to media is generated such that total cost is minimized and total effectiveness is greater than or equal to a user-specified level of effectiveness.				X		X		*
	"utility"	An assignment of all tasks to media is generated such that total cost is minimized and total "utility" is greater than or equal to a user-specified level of "utility."					X	X		

*most easily interpreted strategies

alternatives including changes in (1) objective, (2) constraint, (3) criteria, (4) task criticality variables, (5) psychological variables, (6) task criticality variable weights, and/or (7) utility weights.

After users have explored these alternatives, the task-media assignments can be finalized and entered into the SDT.

Appendix B: Overview of Automated Resource and Cost Estimation Technique

This appendix provides detailed instructions on how to use the Automated Resource and Cost Estimation Technique (RCET). A more detailed description of RCET is contained in the User's Guide: Resource and Cost Estimation Technique. The purpose of RCET is to provide Army Training analysts with an automated tool for estimating instructor requirements and institutional training costs during the earliest phases of the acquisition process.

The Automated Resource and Cost Estimation Technique (RCET) is designed to use input data from the ETES data base management system, the System Description Technology (SDT). Actual calculation of instructors and institutional training course cost in RCET is accomplished by using the VISICALC automated worksheet software developed by Visicorp. The VISICALC worksheet is also used to conduct sensitivity analyses of key parameters.

B.1 CONCEPTUAL OVERVIEW

The Resource and Cost Estimation Technique has three components:

(1) SDT Interface Software - this software is used to select and remove data from the SDT and to format the data for use in the VISICALC program. In addition, it is used to copy the results of the VISICALC program back into the SDT.

(2) Tailored VISICALC Worksheet - this worksheet contains the equations for determining number of instructors and course costs. In addition, it contains all of the commands needed to load and unload the SDT input file, and to conduct sensitivity analyses. This tailored worksheet saves the user from the somewhat tedious process of setting up a VISICALC worksheet and command structure.

(3) Manual Procedures - these procedures describe how to develop input data and how to use the SDT interface software and the tailored VISICALC worksheet.

There are two major products of RCET: (1) a listing of the number of instructors required in the course and (2) a listing of projected costs for the course. An example of the cost elements estimated by RCET is listed in Table B-1. These are the same cost elements used in the Cost Analysis Program of the Army TRADOC Resource Management (ATRM) system.

B.1.1 Calculation of Course Costs

Costs for a new course are estimated by identifying a comparable existing course, obtaining cost data from this course data to reflect the differences in key resource requirements (for example, number of students and number of instructors) between the comparable course and the new course.

This procedure provides estimates of course costs that are (1) empirically based and (2) suitable for the types of high level analyses which are conducted during the early phases of the acquisition process.

Table B-1 Example Cost Elements

PROPOSED COURSE SPREADSHEET

	OMA	MPA	PA	FHMA
DIRECT MISSION				
INSTRUCTIONAL DEPARTMENT	______	______		
FLYING HOUR	______	______		
OTHER	______	______		
SUBTOTAL	______	______		
TROOP SUPPORT				
P8	______	______	______	
P2/3	______	______	______	
AMMUNITION			______	
EQUIPMENT ITEM DEPRECIATION			______	
STUDENT PAY AND ALLOWANCES				
OFFICER		______		
ENLISTED		______		
TRAVEL PAY TO COURSE	______	______		
PER DIEM AT COURSE	______			
TOTAL DIRECT COSTS	______	______	______	
BASE OPERATIONS	______	______		
SUPPORT COSTS				
TRAINING AIDS	______	______		
OTHER	______			______
TOTAL INDIRECT COSTS	______	______		______
TOTAL DIRECT AND INDIRECT	______	______	______	______
TOTAL COST PER GRADUATE	______			

B.1.2 Calculation of Number of Instructors

The number of instructors required in a course is calculated by an automated version of the algorithm listed in the Staffing Guide for U.S. Army Services Schools (DA PAM 570-538).

B.2 PROCEDURAL OVERVIEW

An overview of the procedures in the Resource and Cost Estimation Technique is provided in Figure B-1.

The first step in the application of RCET is the identification of the "reference" course or the comparable existing cousre, which most closely resembles the task and target population requirements of the new course. Procedures for identifying a reference course are contained in the ETES User Guide Manual Procedures. Once the reference course has been identified, cost data for this course is obtained from the Cost Analysis Program (MOS Training Cost) and entered into the SDT.

Reference course information is also used in the construction of the quasi-program of instruction (QPOI) for the new course. Included in the QPOI is a description of the methods to be used in each module in the course, and the student-instructor ratio and instructor contact hours associated with each method. Procedures for constructing a QPOI are contained in the ETES User's Guide. This same guide contains procedures for determining the number of students to be trained. This value is a critical factor in the determination of course costs.

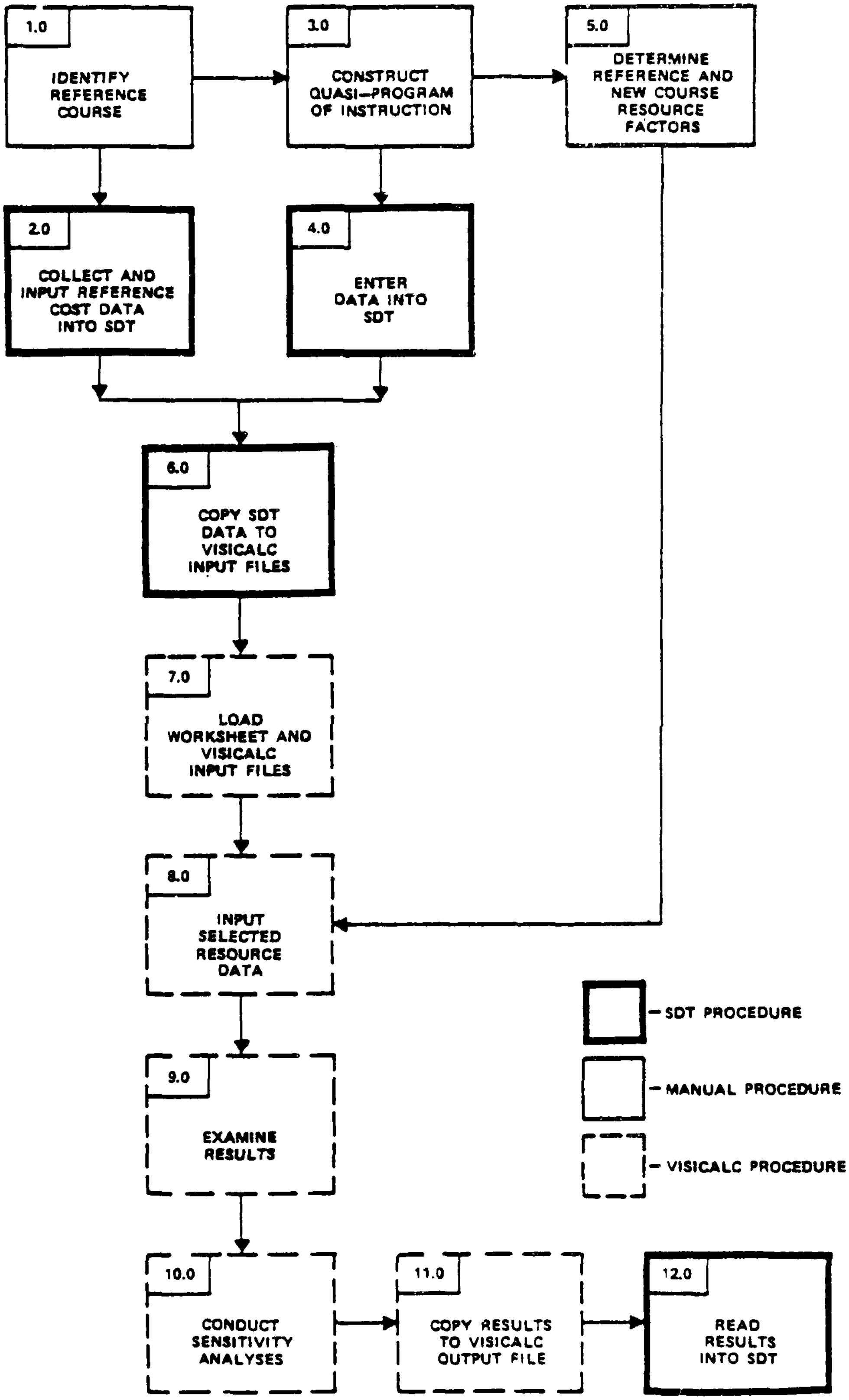

Figure B-1 Overview of Procedures in Resource and Cost Estimation Technique (RCET).

Once the QPOI has been instructed for the new course, information from the QPOI on instructional methods, student/instructor ratios, and contact hours must be entered into the SDT. When this is completed the the user must enter the SDT, enter the Applications mode, select the Resource and Cost Estimation Techniques (RCET), and copy the reference cost data and new course QPOI data onto files which can be read into the VISICALC program.

Once the VISICALC input files have been developed, the user must remove the SDT software diskette, put in the VISICALC software diskettes and enter the VISICALC program. Once into the VISICALC software, a few simple commands may be used to load the SDT input files and RCET worksheet into the VISICALC. When this is completed, a small selected set of resource data for the reference and new course must be entered into the SDT. Course costs and instructor requirements may then be calculated by executing a simple command built into the RCET worksheet.

After examining the initial estimates of course costs and instructor requirements, the user can then use a few commands built into the RCET worksheet to conduct sensitivity analyses of key parameters. When these analyses are complete, the final set of costs for the new course can be copied onto a VISICALC output file. The user can then exit the VISICALC software, enter the SDT software and copy the output file into the SDT data base.

Appendix C - Overview of Automated Training Planning and Scheduling Technique

This appendix provides an overview of the Automated Scheduling and Planning Techniques (APST). A more detailed description of APST is provided in the User's Guide: Automated Planning and Scheduling Technique. APST is designed to assist training developers in describing and monitoring the training development schedule for developing Army weapon systems. APST is designed to be used with the Visischedule software, which is an automated program for describing, monitoring and reporting schedule information and for conducting critical path analyses of schedule events. A data input diskette, describing the events required in the Army's Individual and Collective Training Plan (ICTP), is included in these techniques. This data input diskette contains detailed information on the sequential relationships among the events in the OICTP.

APST is designed to make it relatively easy for training developers to track and monitor the complex relationships among the events in the training development schedule. In addition, by providing an automated capability to monitor the training schedule, it should aid training developers in responding quickly and efficiently to the frequent schedule changes which occur during the develpoment of Army weapon systems.

C.1 CONCEPTUAL OVERVIEW

Construction of training development schedules for emerging systems is a difficult task. Over 100 developmental events are listed in TRADOC Reg 351-9. The sequential relationships among these events are complex and are not described in any systematic and integrated manner in TRADOC Reg 351-9.

Further, the training scheduling process, particularly during the early phases of system development, is characterized by frequent changes and updates. Determination of the impact of these changes is a tedious and time consuming process.

APST contains techniques for using automated VisiSchedule software to track and monitor training develpoment schedule. By using VisiSchedule, the training developer can quickly and efficiently respond to changes in the training development scheudle. Use of the VisiSchedule program is facilitated by the inclusion of an input data diskette which (a) describes the events in the training development process (as specified in TRADOC Reg 351-9), (2) describes the temporal/sequential relationships among these events, and (3) lists the expected duration of these events for a "typical" major Army weapon system. This data diskette significantly reduces data input requirements In addition, it eliminates the need for an analysis of the complex sequential relationships among training development events which are either implicitly or explicitly specified in TRADOC 351-9.

o Capabilities of VisiSchedule Software

As applied to the training development process, the VisiSchedule software can be viewed as providing the following capabilities:

(1) Allows users to systematically describe an integrated training development schedule including information on training development events, the sequential relationships among these events, the duration of these events, the manpower (by labor category) required to accomplish each event, and the costs (that is, salaries) of this manpower.

(2) Allows users to quickly determine the impact of changes to any of the above information.

(3) Allows users to identify the "critical path" in the training development schedule. A "critical" event is one whose delay would impact completion of the whole project.

(4) Allows user to aggregate events to determine total manpower requirements (by paygrade or occupational specialty) and to determine total training development costs.

C.2 PROCEDURAL OVERVIEW

An overview of the procedures for using the automated planning and scheduling techniques is provided in Figure C-1.

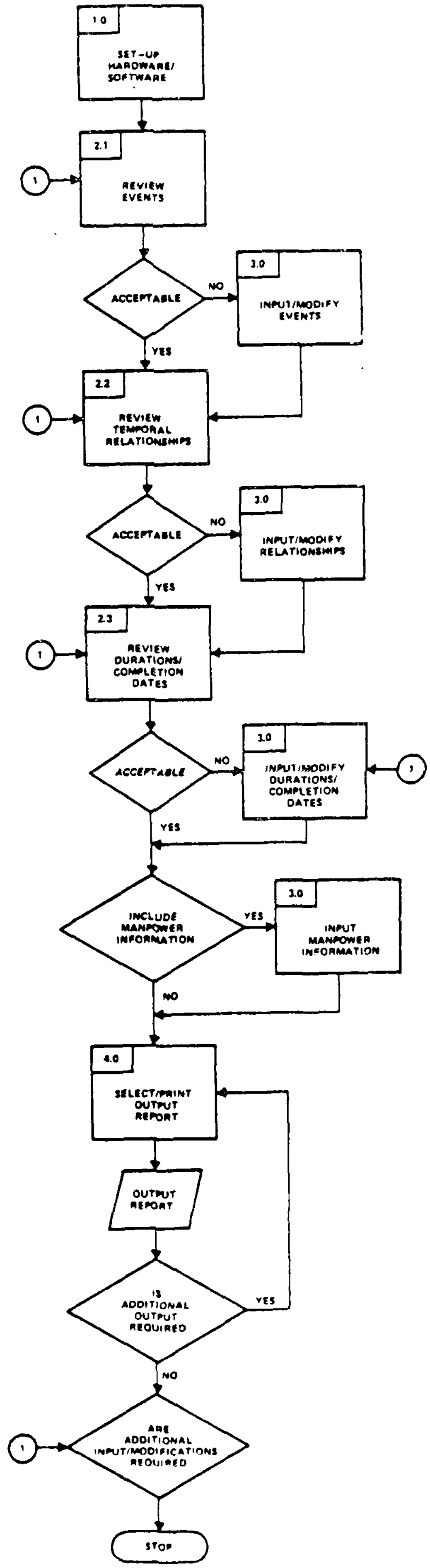

Figure C-1 Overview of Procedures for Using Automated Planning and Scheduling Techniques.

The first procedure involves setting up the hardware and software needed to run the automated techniques. As part of this procedure, the VisiSchedule software and the accompanying input data diskette, describing the ICTP events and their interrelationships are entered into the computer.

In the next three procedures (2.1 and 2.3), the data on the input data diskette describing the ICTP events, their interrelationships, and their durations is reviewed by the user. If the user feels that the existing data is acceptable and, thus, is an accurate description of his/her training development schedule, the user can proceed directly to the output report procedure (4.0). However, it is more likely that the user will want to change the durations or completion deadlines of some of the events; the events themselves and their relationships are less likely to require change.

If changes are required, these changes may be made using the methods described in procedures 3.1 to 3.4. Procedure 3.4 allows users to enter and/or modify data on manpower requirement and costs. Information on manpower requirements must be entered by the user since this information is too system specific to include in the input data diskette.

In procedure 4.0, the user may select from one of four different output reports to describe the training development schedule. After examining these outputs, the user may wish to conduct tradeoff analyses or sensitivity analyses of the schedule input variables. This can be accomplished by changing the input parameters through procedures 2.0 and 3.0.

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APPENDIX D

DESCRIPTION OF PROJECTS RELATED TO ETES

This appendix provides descriptions of the six ARI projects which are directly related to ETES (1) the Hardware Procurement-Military Manpower (HARDMAN) Methodology, (2) the Man Integrated System Technology (MIST), (3) the Training Efficiency Estimation Model (TEEM), (4) the Training Developer's Decision Aid (TDDA), (5) the Model for the prediction of the effectiveness of Training Devices (TRAINVICE), and (6) the Army Manpower and Personnel Requirements Process (ARMPREP). More details on these six projects are provided in the subsections which follow.

D.1 MILITARY MANPOWER VERSUS HARDWARE PROCUREMENT (HARDMAN)

The HARDMAN methodologies provide the Navy and the Army with a systematic means of estimating human resource requirements (manpower, personnel, and training) during the earliest phases of the Weapon System Acquisition Process (WSAP). The integrated models and data bases of the methodologies are designed to (1) assess manpower, personnel, and training requirements for proposed sytems; (2) determine the impacts of manpower, personnel, and training requirements; and (3) identify and evalute tradeoffs which would alleviate unfavorable impacts. DRC has also extended the capability of HARDMAN through increased automation and the development of proprietary software packages. These advances have significantly cut cost and response time and more closely aligned the output products of HARDMAN with the information needs of Program Managers, resource sponsors and their staffs.

In its present form, DRC's HARDMAN Methodology is composed of six interrelated steps which can be iterated in a timely fashion for the analysis of alternative design proposals. The first step is conerned with various aspects of data collection, generation, formatting, and analysis. It also includes the establishment of an automated audit trail or program record of all input data, analyses and output products. The final five steps involve data evaluation with respect to acquisition program goals and constraints.

The establishment of the consolidated data base triggers the methodology and ensures that all analyses pertaining to a new weapon system use a common data source. Consequently, consistent definitions and collection procedures are employed in assembling data on operator and maintainer functions, the weapon's operational mission/scenario and maintenance concept, its cost factors, and its manpower and training sytem support requirements. The proposed weapon system's demand, in terms of manpower, personnel, and training is determined in Steps 2 through 4 and compared to the projected supply of such resources at system Initial Operational Capability (IOC) in Step 5. Significant shortfalls and equipment sources of high resource demand are identified. In Step 6, the methodology is iterated to examine alternative designs, training methods and media, and total force tradeoffs. Thus the program manager can participate in the design process with a heightened awareness of the training and manpower demands of a new weapon system, thereby ensuring its supportability as well as its mission capability.

DRC's HARDMAN Methodology has been used on a wide range of all three Military Services, including the Shipboard Intermediate Range Combat (SIRCS); the lSD-41, a new class of guided missile destroyer (DDG-51); the Submarine Advanced

Combat System (SUBACS); the Army's Divison Support Weapon System (DSWS); the Corps Support Weapon System (CSWS); and the Remotely Piloted Vehicle (RPV); and in modified form with the Air Force's Combat Identification System (CIS).

These applications have fully exercised all of the analytic capabilities of the methodology. Additionally, they have demonstrated its capability to provide timely, accurate support for program management and review. Specifically, significant or problematic human resource demand generated by equipment design has been targeted early in program development; alternative system and subsystem configurations have been evaluated through tradeoff studies; and the methodology's consolidated data base, supported by carefully documented resource design analyses, has been used to build an audit trail of manpower, personnel, and training assessments and tradeoffs.

D.2 MAN INTEGRATED SYSTEMS TECHNOLOGY (MIST)

The United States Army Research Institute for the Behavioral and Social Sciences (ARI) is developing a technology which integrates manpower, personnel and training (MPT) considerations throughout the Weapon System Acquisition Process (WSAP). Its goal is to ensure the effective planning for and utilization of projected human resources for operational readiness. The technical activity required to achieve this objective has been organized into a major research and development program entitled Man Integrated Systems Technology (MIST). DRC has been selected as the contractor for MIST which is an extensive (5 year, 32 man-years) multimillion dollar effort.

MIST will consist of the necessary technology and management procedures to address the following considerations: (1) the

treatment of human resources as a performance and cost factor during system concept formulation, (2) the planning and forecasting of manpower information, (3) the parallel development of associated training systems with weapon systems, and finally (4) the specification of test and evaluation issues to ensure human resource accountability, and to support the ASARC/DSARC review at each of the major development milestones. MIST in particular will integrate and demonstrate the technical relationships among these considerations, and provide the necessary methodology to ensure their effective treatment during the design process from a performance, manpower, training and cost point of view. In addition, MIST will demonstrate how these technical considerations are related and responsive to the Army's Life Cycle System Management Model (LCSMM), and to relevant Army regulations and responsible agencies. MIST will further provide a comprehensive framework for the assessment and integration of other relative technologies and information as they are identified or developed.

When fully developed, MIST will serve as an integrating mechanism providing efficient interfaces for information exchange and feedback among concurrent activities and/or processes involving industry and government, system design engineers and support planners, Army acquisition managers, and the Army's oversight bureaucracies in the Department of Defense and the Congress. Hence, MIST will provide the design and implementation of more comprehensive and responsive data bases and technical/management procedures employed in prime and support system development, acquisition and operation.

When completed, MIST will be composed of three principal components:

- Analytical Tool Designed to Support Program Managers, TRADOC System Managers, Acquisition Managers (e.g., Weapon System Manager (WSM) in DARCOM), and their staffs/supporting agencies;

- A system-specific data base to provide a single point source for all man-machine data (input to the tools, output from them and decision support information for program documentation and reviews) collected for an emerging system.

- A management information system to link MIST users and the data base in an effective communication network within the framework of the Life Cycle System Management Model.

Hence, MIST will provide an important new capability within the Army. This capability is embodied in a cost-and time-efficient system for human resource requirements analysis early in weapon system development. MIST will capture the most recent advances in both man-machine technology and automated data processing to provide a system which is user-friendly at the operational level and responsive to the analysis and information requirements of users at several levels within the chain of command. Finally MIST will "fit into the real world" by providing effective interfaces to existing management information systems and data bases for logistic support analysis, training system development and personnel planning in DARCOM, TRADOC and the Army Staff.

D.3 TRAINING EFFICIENCY ESTIMATION MODEL (TEEM)

TEEM is an interactive computer-based aid designed to assist training developers in early evaluation and generation of training program components. At the foundation of TEEM is a set of psychological variables which reflect the training information contained in a system task description. This is in contrast to the normal textual form in which task descriptions are usually developed. A representation by variables was chosen bec use early task descriptions are often not in standard formats, may change quickly, and may require elaboration by design engineers or other subject matter experts. A predetermined set of standard psychological variables provided a starting point which could be depended upon for input into the fixed operational code of a computer program.

Initial task groups corresponding to procedures that should be trained together are generated through an algorithm that clusters tasks based upon internal similarity along the psychological variable dimensions. After clustering is complete, a task group has maximum difference between task clusters. The clusters serve as an automated estimate for use during the initial formulation of a training program. Task groups are then modified, if needed, based on the expertise of the analyst or outside mitigating factors such as management and cost constraints that would normally not be included in the psychological variables.

Selection of concrete, costable components such as media and method of training are based upon the similarity of a group of task variable requirements to the ability of a media or method to manipulate psychological variables during training. Selection is accomplished by representing each training program component by a description in the same set

of psychological variables. A task is also coded as a vector of variables with an assocated variable value for each dimension representing applicability or non-applicability. Selection of a program component is performed by automatically matching each task to each potential component and selecting the component with the higher match of critical variables.

If an already existing training component is being evaluated, the matching process is utilized in reverse to generate a figure of aggreement between the theoretical maximum possible under the task and hardware conditions and the actual match under a particular alternative. The normalized numeric value of this match is called the efficiency ratio.

After efficiency ratios have been generated for potential training programs a final selection for the best training approach is made based on pair values of gross dollar costs and their efficiency ratios. Together the values represent an early form of cost-effectiveness ratio for each approach. The best candidate programs are selected for detailed cost analysis through a much more complex accounting program and given increased program specification.

TEEM was constructed with the realities of the early training situation in mind. It does not assume extensive and accurate information. It is "user friendly" with step-by-step guidance to individuals unfamiliar with micro-computers. It is designed to accommodate local school needs and training development procedures without major program changes. It is also flexible enough to be quickly modified based upon improvements in psychological research and field experience.

D.4 TRAINING DEVELOPER'S DECISION AID (TDDA)*

The Training Developer's Decision Aid (TDDA) was designed to assist training development specialists in applying the Instructional Systems Design (ISD) process. The ISD process is a comprehensive technique for the systems approach to development training. Applied Science Associates, Inc. (ASA), working in collaboration with the Army Research Institute Field Unit at Fort Bliss, Texas, has developed, tested, revised, computerized, and conducted tryouts of the model at five Army schools.

The TDDA is intended to be an aid to training developers who need technical assistance in designing or redesigning training and to streamline the process of making training decisions. The TDDA is procedural in nature; it leads training developers through a series of procedures which specify: (1) what decisions are to be made, (2) a rational order for decisions, and (3) the nature and sources of information required to make valid training decisions. The model also serves to organize and retain information that is gathered and processed during the course development process.

The TDDS model can be used with partial or complete task lists or performance objectives. It is not necessary to redo the job analysis in order to use the TDDA process. This reflects a training development philosophy that a thorough analysis of the job early in the training development process is essential for making valid training development decisions.

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* Derived from Frederickson, et al (1981).

The Job Analysis Module requires the greatest input form subject matter experts (SMEs). Those who hold the MOS being analyzed and selected to serve as SMEs are expected to be expert job performers with at least eighteen months of recent on-the-job experience at an operational site. This is an essential requirement for the successful application of the model. The model is sensitive to quality of the input data and information, since all three major decision (what, where and how to train) are directly tied to input.

There are two separate parts to the SME input in the Job Analysis Module. First, the initial task list is generated by exercising function analyzers. Then, the task list is verified as correct and complete. This should be carried out by a second set of SMEs. At the time the tasks are verified, the remainder of the input information is obtained from the SMEs. The output of this module provides the answer to the question, "What should be trained to prepare someone to perform in their MOS?"

The Functional Learning Requirements Module requires inputs from two sources, MOS SMEs and course development instructor personnel in order to make decisions of how to train. The information generated in this module is used by the course developer to specify the functional characteristics of the training program. The emphases in specifying these characteristics are on how best to communicate the learning objectives, job context and consequences of task performance, and on providing for efficient practice for acquiring special job skills.

Development of the course requires that the relationships between tasks be determined. The last SME input provides the information for describing these relationships. Tasks are related in three ways. First, the same skills may be

required in the performance of different tasks. Knowing which skills are redundant allows for more efficient scheduling and sequencing of instructional elements. Second, some tasks must be performed on the job before other tasks can be performed. For example, a piece of equipment cannot be repaired before the cause of the malfunction is isolated. Or, an intelligence report cannot be prepared before the intelligence information and data are analyzed. The output of these tasks are inputs to the subsequent tasks. The third relationship is merely chronological. One task must be performed prior to a second one but there is not direct output-input dependency. For example, a weapon system has to be emplaced (a collective task) and made ready for action, before it can be used to engage hostile targets, which may or may not occur.

The dependency relationship information is provided by SMEs and is then used to build a task dependency hierarchy. The product is considered to be a general course structure upon which the course map can be built. The task dependency information is generated in the Functional Learning Requirements Module, but is analyzed in the Structure Designation Module.

Information and data from several earlier inputs are used in the last module to make decisions as to where the training should be conducted. The task criticality data is one of the primary inputs to this decision. Additionally, the instructional setting characteristics and school context information are used in reaching these conclusions.

The TDDS model then is used to make three major decisions: what to train, how to train, and where to train. Some decisions are made algorithmically and others are heuristically determined.

D.5 A MODEL FOR THE PREDICTION OF THE EFFECTIVENESS OF TRAINING DEVICES*

TRAINVICE is a methodology for the systematic assessment of the characteristics of training devices under development. The model is based on the assumption that certain attributes to be assessed in the training situation will lead to transfer of training to the operational situation. Therefore, the higher the rating on the assessment factors, the higher the transfer that will take place and the more effective the device. The model provides a framework for the making of these judgments. The three variables entering into the assessment are: (1) the transfer potential of the device, (2) the learning deficit to be overcome and (3) instructional effectiveness. As with any model, its effectiveness depends on the adequacy of the input data. Inputs into the model consists of descriptions of tasks and subtasks represented in the operational situation, as circumscribed by the training objective, and those represented in the training device. The controls and displays and their functions for both situations are listed. In addition, the skills and knowledges involved in each subtask in the operational situation are formulated for use in the model. Using these inputs, judgments are made using rating scales. The subtasks in the two situations, operational and training, are compared to ascertain if provision is made for representation of the subtasks in the training device in the commonality analysis. Next, the displays and the controls for both situations are compared on physical and functional similarity. The more similar the display or control in the training device is to the

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* Derived From Narva (1979).

operational situation, the higher the score. This is based on the premise that the greater the physical or functional similarity, the greater the transfer of training that will result. Physical similarity refers to the appearance and physical aspects of the displays and controls involved; i.e., their "fidelity"; functional similarity involved in the operation of control, in information processing terms. The learning deficit analysis is based upon (1) the assessment of the level of proficiency in each skill or knowledge for the students upon entering the training situation, (2) the desired level of proficiency in each skill or knowledge for the students upon leaving the training situation, and (3) the difficulty (in terms of training time) of training in the skills or knowledges involved in a subtask. This analysis yields a weighted learning deficit for each subtask. The judgments concerning the level of each skill or knowledge are made using scales adapted from Demaree (1961). The last analysis involved in the TRAINVICE model is an assessment of how well the training device adhers to "good" training techniques. In order to perform this analysis, each of the subtasks is cast into one or more categories of behavior. These categories are those of Braby, et al (1972), which are derived for an earlier behavioral categorization by Willis and Peterson (1961). For each of the behavioral categories represented in the subtask, a list of guidelines, also those of Braby, et al. (1972), are consulted and judgments made of the degree to which the guidelines are followed, or not followed, relative to the manner in which the subtask is represented in the training device. The guidelines are broken up into those dealing with the stimulus, response, and feedback aspects of the training situation. For each subtask, the lowest obtained score on each of the three aspects is used to derive an average training technique score. All of the preceding rating, are then fed into an equation to formulate

an index of prediction of training effectiveness, ranging from 0 to 1. This equation is as follows:

$$\frac{(Ci \times Si \times Ti \times Di)}{Di}$$

where C is task commonality, S similarity, T training techniques, and D the training deficit scores for each subtask. The equation was derived from a transfer of training equation of Gagne, Foster and Crowley (1943), which was for use with empirical data, while the TRAINVICE extrapolation deals with judgments made concerning aspects of a device assumed to bring about subsequent transfer of training.

A validation study has been performed on the model, utilizing data obtained during the course of two field studies as criteria against which to compare the predictions derived from use of the model (Wheaton, et al., 1976). The devices were tank gunnery trainers involved with burst-on-target techniques and tracking with the main gun of the M60A1 tank. In each case, the prediction of no differences between the training devices involved was found to be consistent with the equivalence in transfer actually found in utilization of the various devices. This was felt to be a promising but not definitive finding.

In order to obtain additional validation data on the model, and also to obtain experience in utilization of the model to determine if there were aspects that might be changed in order to enhance the practicality of utilization of the model, the Army Research Institute personnel applied the model to two maintenance trainers undergoing evaluation at

the Army Ordnance Center and School. This afforded the opportunity to obtain data within a different context than that dealt with by gunnery trainers.

These trainers were concerned with automative trouble-shooting. No difference in training effectiveness was predicted for the two trainers, which agreed with the results of the empirical evaluation. Various aspects of the model which caused difficulty in its utilization were noted and influenced the development of the modified version . In addition, ARI conducted a three-day workshop, in which the developers of the original model and individuals who had utilized the model or had an interest in its utilization participated, and this furnished further ideas for possible modification.

D.6 ARMY MANPOWER AND PERSONNEL REQUIREMENTS PROCESS (ARMPREP)

The Systems Manning Technical Area of the Systems Research Laboratory, US Army Research Institute, is promoting a research thrust known as Manned System Integration. One major component of this program is the development of improved procedures for the manpower planning process. The major objective of this proposed research is the development of new, innovative and effective techniques to support the determination of manpower and personnel requirements. ARMPREP will include: methodologies to accurately estimate manpower quantity and skill level of personnel through derivation of behavioral requirements and subsequent translation into Military Occupational Specialty (MOS) and other relationships; techniques to aggregate manpower demand of new systems for comparison with available supply; requirements and attributes of a manpower requirements management information system; and finally, the specifica-

tion for a computer interactive system. ARMPREP is intended to provide tools for potential integration into the current manpower planning process by cognizant Army agencies. In essence, ARMPREP has four principal components each with its own identifiable research products. These four components are:

- o Manpower and Personnel Requirements Determination Methodologies (MANPERS).
- o Aggregation Procedures of Manpower Demand (TOTAL MANPERS).
- o Requirements for a Manpower Requirements Management Information System (MARMIS).
- o Computer Interactive System for determination of Manpower and Personnel Requirements (AUTO MANPERS).

MANPERS

The MANPERS component will provide the techniques and methodologies to formally quantify manpower and personnel requirements. These formal methodologies will aid in the timely and accurate determination of manpower and personnel requirements. In addition, these methodologies are intended to standardize the manpower and personnel requirements determination process to provide information of a consistent nature of use to Army personnel subsystem developers. Specific aspects of the MANPERS component will consist of the following attributes:

(a) The development of a taxonomic model to derive behavioral requirements based upon new system Task

Descriptive Data (TDD) and translation of these behavioral requirements into MOS and associated decisions. The model will define the requisite data to be included . This input data will be obtained from sources such as LSA, Task and Skill Analyses (TASA), system requirements and doctrine documents, engineering design data and training plans. The model will specify the level of specificity of data congruent with each phase of the LCSMM. In addition, the model will identify the process by which the behavioral requirements are derived (i.e., the taxonomy) and the means by which the level of data specifity is embraced by the taxonomy. Finally, the MANPERS methodologies will guide the selection of personnel for a given job in a new system based upon the behavior (or performance) expected of him, as opposed to the current method which involves the preselection of MOS category, previous to and/or without rigorous documentation to support such a choice.

(b) Integration with events and activities of the LCSMM, ILS (LSA) and ISD. The MANPERS process will provide the necessary manpower input to decision makers at critical system development milestones to encourage optimization of manpower planning. Where possible it will support the determination of manpower related life cycle and support costs relative to specific systems. Through involvement with the ISD model, the MANPERS component will support a margin of requirements for new equipment training (of the Material Developer) with training requirements (of the Combat Developer) as identified by specific schools. Finally, the MANPERS component will

serve to provide increased accuracy of information used in development of draft plan TOEs (as well as throughout the TOE planning process).

(c) A final aspect of the MANPERS component is the development of a MANPERS manual to include: job aids, examples, procedural models, instrument formats and presentation methods for thorough manpower and personnel requirements determination. The MANPERS manual will provide a tool for quick responses to needs to generate quality information on a timely and economical basis. The MANPERS manual will facilitate the standardized determination and presentaiton of requirements to increase the utilization of information by decision makers. Finally, the MANPERS manual will provide a competent training tool to producers of manpower and personnel requirements (especially for those new to the job and content area).

TOTAL MANPERS

The TOTAL MANPERS component will provide the techniques for aggregation of manpower demand for comparison with available supply data. Manpower demand is defined as quantity of manpower by quality of personnel (e.g., skill level) both within and across systems. In short, it is a quantity by quality of manpower comparison between demand and supply.

Specific aspects of the TOTAL MANPERS component include:

(a) Development of technqies which can provide quantity by quality loadings of manpower demand for a specific system. The data used by TOTAL MANPERS procedures will be an extension of the

basic MANPERS tools by relating some paradigm of personnel performance or behavioral requirements.

(b) Another aspect of this component will be to provide techniques which aggregate information for quantity by quality of manpower across systems through comparison of manpower demand loadings held in common with personnel performance or behavioral requirements.

(c) A final aspect of the TOTAL MANPERS component will be its coordination with events and activities of the LCSMM, the PPBS (through SACS and TOE planning) and ILS to insure the timely determination of requisite manpower information, and authorizations, as well as changes to force structure and composition.

MARMIS

The MARMIS component will provide the manpower management procedures to integrate the MANPERS and TOTAL MANPERS components with the Army manpower related documentation process. In addition, current manpower management and documentation procedural deficiencies and recommended fixes will be identified. The most significant activity in this component is to support current Army actions in management information systems developments relating to the manpower planning process through the specification of the requirements and attributes of MARMIS. Specific aspects of the MARMIS component include:

(a) Determination of manpower management and documentation procedures to facilitate the utilization of manpower and personnel requirements

methodologies and aggregation techniqes so as to improve the timeliness and quality of requirements generated.

(b) Identification of means to improve accountability of manpower and personnel requirements documentation to identify potential economies in management and documentation flows. This will take into account organizational and technical complexities which serve to work against desired results. In addition, these efforts will facilitate improved manpower planning as well as to focus upon deficiencies for possible resolution.

(c) Means to control manpower related information will be developed so that many activities concerned with other interests (e.g., LCSMM, SACS and TOE planning, and ILS) can be fully coordinated with, such that appropriate milestone are achieved on a timely basis and the requirements of other activities are met as they relate to manpower concerns.

AUTO MANPERS

The AUTO MANPERS component will provide the basis for development of a computer interactive system for determining manpower and personnel requirements by developing the requirements, attributes and specification for AUTO MANPERS. AUTO MANPERS is intended to provide a basis for MANPERS an TOTAL MANPERS methodologies. Specific aspects of the AUTO MANPERS component will support development of a proposed computer interactive system by addressing the following:

(a) Ease of documentation, update and edit of requirements through use of an online, interactive ADP system which provides: continuous availability to authorized users, embedded training or job aids, and quick response cross-referencing capabilities with related manpower documentation. These capabilities should lead to increased accuracy and timeliness of requirements production and utilization as well as potential economies in administrative support.

(b) Another potential aspect of this component is the development of a built-in analytic model and mathematical capability to increase the rigor of manpower requirements determination. For example, whenever mathematical calculations or transformations are required the formulas should be readily accessed on the system.

It should be noted that a training device can be considered to be a large system in and of itself. Thus, it has its own associated resource requirements. Estimation of these additional resource requirements is beyond the current scope of ETES. However, it is expected that these resource requirements could be estimated by comparability analysis. Input to the determination of training device resource requirements is provided by the task requirements associated with each device which are determined in Procedure 2.0 and the instructional programs developed during Procedure 4.5.

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Appendix E. Data Source Index.

SERVICE	TASK INFORMATION	PERSONNEL QUALIFICATION INFORMATION	(NOT REQUIRED) EVALUATION	TRAINING PLANS	COURSE INFORMATION	INSTRUCTOR DETERMI-NATION INFORMATION	TRAINING COSTS	INSTRUCTIONAL RESOURCES
ARMY	1. Trainer's Guides 2. Soldier's Manuals 3. Army Training and Evaluation Program (ARTEP) 3. Comprehensive Occupational Data Analysis Program (CODAP)	AR 611-201 Enlisted Career Management Fields and Occupational Specialties	1. Skill Qualification Test (SQT) 2. Army Training and Evaluation Program (ARTEP)	DA PAM 351-9 EPMS Master Training Plan	1. DA PAM 351-4 US Army Formal School Catalog *2. TRADOC REG 350-19 US Army Service Schools and Training Center Class Schedules (Individual School Schedules) 3. Programs of Instruction (POI)	*Under Revision	Cost Analysis Program (MOS Training Costs) RCS ATRM-159(R) TRADOC REG 11-5	1. DA PAM 310-12 Index and Description of Army Training Devices 2. US Army Comprehensive Plan for Training Devices 3. Training Device Development with Logistics Implications 4. TRADOC PAM 71-9 TRADOC Training Devices for Army-wide use
AIR FORCE	*1. AFR 35-2 Occupational Analysis (CODAP) *2. Specialty Training Standards (STS)	AFR 39-1 Airman Classification Regulation	Skill and Knowledge Test	AFR 50-7 Military and Technical Training Program and Status Report (RCS HAF-T29) *AFR 35-14 USAF Training Pipeline Management Program	1. AFR 39-1 Airman Classification Regulation 2. AFM 50-15 USAF Formal Schools Catalog 3. Plans of Instruction (POI)	*1. ATCM 26-3 ATC Manpower Standards 2. Plans of Instruction (POI)	AFR 173-13 USAF Cost and Planning Factors Regulation	*TBD
NAVY	1. Navy Occupational Task Analysis Program (NOTAP)	NAVPERS 18068D Manual of Navy Enlisted Manpower and Personnel Classification and Occupational Standards	Advancement and Rating Examination	1. Catalog of Navy Training Programs (CANTRAC) 2. NAVPERS 18068D Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards	*1. Naval Integrated Training System (NITRAS) 2. Curriculum Outlines	*1. Naval Integrated Training System (NITRAS) 2. CNET-INST 5311.1 Specialized Training Staffing Requirements-Computation of *3. Schedule of classes	*TBD	*TBD
Marine Corps	*TBD	MCO P1200.7D Military Occupational Specialties Manual (MOS Manual)	*Field Skill Training Program (FST Program)	*TBD	1. MCO P1500.12 Marine Corps Formal Schools Catalog *2. MCO P7100.8E Course Input Requirements	MCO P5320.5C Personnel Requirements	*TBD	*TBD

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
1. Task Information	Individual Enlisted Tasks Accomplished by MOS/Skill Level	TRADOC Cir 351-28 Soldier's Manuals, Commander's Manuals and Job Books Policy and Procedures	DA Pam 310-3 Index of Doctrinal Training and Organizational Publications	Trainer's Guides (FM's) Soldier's Manuals (FM's)
	Individual Enlisted and Officer Tasks Accomplished by MOS/SSI		None	Training Development Information System (TDIS) (Computer Data Base)
	Individual Tasks Accomplished by Job/Duty Position		Contact: MILPERCEN 325-9272/9493	Comprehensive Occu-pational Data Analysis Program (CODAP)
	Individual Tasks Accomplished for Operation and Maintenance of Equipment		Contact: ILS Manager for System	Logistics Support Analysis Record (LSAR)
	Collective Tasks	TRADOC Reg 310-2	DA Pam 310-3 Index of Doctrinal Training and Organizational Publications	Army Training and Evaluation Program (ARTEP)

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
2. Personnel Classification Information	Enlisted CMF/MOS/ASI/ Skill Levels/Duty Positions	AR 611-1 Military Occupational Classification Structure Development and Implementation	None	AR 611-201 Enlisted Career Management Fields and Occupational Specialties
	Warrant Officer MOS/ ASI/SQI/Unit Assignments/ Positions		None	AR 611-112 Manual of Warrant Officer Military Occupational Specialties
	Commissioned Officer SSI/SQI/Duty Positions		None	AR 611-101 Commissioned Officer Specialty Classification System
3. Evaluation	Individual Qualification	TRADOC Cir 351-5 SQT Policies and Procedures	Contact:	Skill Qualification Tests (SQT)
	Collective Training Evaluation	TRADOC Reg 310-2 Development, Preparation and Management of Army Training and Evaluation Program (ARTEP)	DA Pam 310-3 Index of Doctrinal Training and Organizational Publications	Army Training and Evaluation Program (ARTEP)
	Cost and Effectiveness Studies	TRADOC Reg 350-4 The TRADOC Training Effectiveness Analysis (TEA) System TRADOC TEA Handbook	Contact: 1. TEA Branch or Appropriate Division at Proponent School 2. TRASANA Data Base	Cost and Training Effective Analysis (CTEA)

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
4. Training Plans	Individual MOS Training Plans	TRADOC Cir 351-3 Training Requirements Analysis System (TRAS)/Individual Training Plan (ITP)	Contact: Proponent School	Individual Training Plans (ITP)
	Same as Above	TRADOC Reg 351-1	None	Individual Training Plan System (ITPS) (Computer Data Base - Under Development)
	Training Plans for Current and Planned Formal and Extension Enlisted Courses		None	DA Pam 351-9 EPMS Master Training Plan
	Current Training Paths		None	Military Occupational Specialty Training Cost Handbook (MOS B) Volume I Enlisted MOS's, Volume II Commissioned and Warrant Officer MOS's
5. Course Information	Synopsis of Current Resident Courses		None	DA Pam 351-4 US Army Formal School Catalog
	Schedule of Current Resident Courses			TRADOC Reg 350-19 US Army Service Schools and Training Center Class Schedules

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
5. Course Information (continued)	Resident Course Outlines	TRADOC Cir 351-12 Format for Programs of Instruction (POI)	Contact: Proponent School or Training Center	Program of Instruction (POI)
	Correspondence Courses	TRADOC Cir 351-2 ACCP Subcourse Policy	DA Pam 351-20 Army Correspondence Course Program, General Volume	DA Pam 351-20-X Army Correspondence Course Program, Specific Schools
	Proposed Courses (Late in WSAP)	TRADOC Cir 351-3 Training Requirements Analysis System (TRAS)/ Individual Training Plan (ITP)	Contact: Proponent School	Individual Training Plan Proposal (ITPP)
	Proposed Courses (Early in WSAP)	TRADOC Cir 351-19 Individual and Collective Training Plan for Developing Systems - Policy and Procedures	Contact: Proponent School	Individual and Collective Training (ICTP)
	Synopsis of Current Extension Training Course for Organizations Other Than TOE Units	MIL-M-63040 Military Specification Manuals, Technical: Extension Training, Materials for Integrated Technical Documentation and Training (ITDT)	None	DA Pam 350-100 Extension Training Materials, Catalog, Consolidated MOS Catalog

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
5. Course Information (Continued)	Synopsis of Current Extension Training Courses for TOE Units		DA Pam 310-1 Index of Administrative Publications	DA Pam 350-XXX-X Extension Training Materials Catalog by ARTEP
	Synopsis of Extension Training Courses		None	Army Extension Training Information System (AETIS) (Computer Data Base)
	Synopsis of Current and Proposed Extension Training Courses		None	Extension Training Material Status List (Published Quarterly)
6. Instructor Determination Information	Instructor Contact Hours (ICM) for POI's	TRADOC Cir 351-12 Format for Programs of Instruction (POI)	None	TRADOC Form 377-R ICH Computation Worksheet and ICH Computation Summary (Part of POI)
	• DA Student/Instructor Ratios for Types of Instruction • Procedure for Determining Number of Instructors in Service Schools		None	DA Pam 570-558 Staffing Guide for US Army Service Schools
	TRADOC Student/Instructor Ratios for Types of Instruction		None	TRADOC Cir 351-12 Format for Programs of Instruction (POI)

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
6. Instructor Determination Information (Continued)	Procedure for Determining Number of Instructors in Training Centers		None	DA Pam 570-555 Staffing Guide for US Army Training Centers
	School Report to TRADOC: • Class Frequency • ICH's • Number of Students	TRADOC Reg 11-5 Cost Analysis Program (MOS Training Costs)	Contact: 1. Individual School or 2. TRADOC Resource & Economic Analysis Officer ATRM-RA	TRADOC Form 812-R TRADOC School Course Data
7. Training Costs	Aggregated Enlisted and Officer Course Costs By MOS/SSI		None	Military Occupational Specialty Training Cost Handbook (MOSB), Volume I Enlisted MOS's, Volume II Commissioned and Warrant Officer MOS's
	Detailed Enlisted and Officer Course Cost Reports and Data	TRADOC Reg 11-5 Cost Analysis Program (MOS Training Costs)	None	Cost Analysis Program (MOS Training Costs) Requirements Control Symbol ATRM-159(RI) Reports
	Other Course Costs	None	None	Training Center/School Associated with Course

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
8. Instructional Resources	Existing Training Devices	TRADOC Cir 108-1 Training Aids Support Center (TASC) Training Aids Device System	None	DA Pam 310-12 Index and Description of Army Training Devices
	Existing Training Device	Same as Above	None	TRADOC Pam 71-9 Catalog of TASO Training Devices
	Location of Existing Training Devices		None	Army-wide Devices Automated Management (ADAM) (Computer Data Base)
	Planned/Proposed Training Devices		None	US Army Comprehensive Plan for Training Devices
	Planned Training Devices		None	Training Device Development with Logistics Implications
	Planned/Proposed Training Devices		None	Devices and Systems Training Information System (DSTIS) (Computer Data Base)
	Existing Training Devices Audiovisual Programs, Graphics Training Aids, Video Tapes		None	Army Extension Training Information System (AETIS) (Computer Data Base)

CATEGORY	DATA	SOURCE REFERENCE	SOURCE INDEX	SOURCE
8. Instructional Resources (Continued)	Motion Pictures and Related Audiovisual Aids		None	DA Pam 108-1 Index of Army Motion Pictures and Related Audiovisual Aids
	Video Tapes		None	TRADOC Pam 350-33 Educational Video Tape Catalog
	Other Resources		Contact: TASC or Proponent School/Training Center	Locally Produced Catalogs/Indexes
	Programmed Instruction			DA Pam 690-22 Guide for Using Existing Programmed Instructional Materials

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Appendix F. List of Potential Performance Measures.

Speed
Acceleration
Range
Vertical Manueverability
Horizontal Manueverability
Carrying Capacity
Rate of Fire
Firing Capacity
Firing Payload Range
Firing Accuracy
Communication Range
Communication Rate
Communication Capacity
Communication Distortion/Accuracy
Detection Range
Detection Capacity
Detection Accuracy
Recovery Time
Probability of Survival
Memory Capacity
Processing Speed
Processing Accuracy
Processing Capacity
Operational Availability
Achieved Availability
Inherent Availability
Availability
Mean Time Between Failures (MTBF)
Summary Measures – Elapsed Maintenance Time
Mean Corrective Maintenance Time
Mean Preventive Maintenance Time
Mean Active Maintenance Time
Maintenance Downtime
Mean Time Between Maintenance Actions (MTBMA)
Mean Active Corrective Maintenance Time
Mean Active Preventive Maintenance Time
Maximum Active Corrective Maintenance Time
Turn Around Time
Summary Measures – Manhours
Mean Maintenance Manhours per Equipment Operating Unit
Mean Maintenance Manhours per Maintenance Action
Mean Maintenance Manhours per Month of System Operation
Mean Corrective Maintenance Manhours
Mean Preventive Maintenance Manhours
Detailed Measures (per Task and Task Type)
Elapsed Time
Maintenance Hours
Number of People Performing
Frequency of Maintenance Action

APPENDIX G

DESCRIPTION OF TRAINVICE

This appendix provides a description of the TRAINVICE procedures. The description is taken from Training Device Requirements Document Guide.

Evaluate Theoretical Device Concepts--If no existing devices approximate the proposed device's requirements or if alternative existing device concepts are available, one may wish to derive new alternative concepts that have no existing hardware representation. Theoretical device concepts are those device concepts for which no actual training device equipment now exists but for which such equipment could theoretically be constructed. As with existing device concepts, theoretical device concepts are specified by:

- Tasks
- Task elements
- Controls and displays

For theoretical device concepts, these data are all defined in the task training requirements already developed. A theoretical device concept specified by all of the task training requirements would represent the "ideal" device; by definition, it would meet all task training requirements. Because of practical constraints (e.g., cost, development time), it may not be possible to develop the "ideal" device. Some trade-offs must be made. These affect tasks, elements, controls, and displays which specify a device. Thus, for practical reasons, it is desirable to be able to evaluate alternative theoretical device concepts. The procedures described below allow this; regardless of whether existing or theoretical alternative device concepts are being evaluated, the procedures are applied in the same way.

Analyze Alternative Device Effectiveness

Task Commonality--Table 27 is used to analyze each task requiring training on a training device. The table is used in deriving a task commonality index for each training device or training device concept under consideration. The following procedure is applied to one task at a time.

1. List the task elements down the left column of Table 27.
2. List the training devices or training device concepts to be assessed across the top of Table 27.

TABLE 27. TASK COMMONALITY ANALYSIS

NAME OF TASK ______________________________

REQUIRED TASK ELEMENTS	DEVICE A	DEVICE B	DEVICE C
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total number of 1's			
Task Commonality Index			

$$\text{Task Commonality Index} = \frac{\#\text{ of 1's for Device}}{(\#\text{ of Rq'd Task Elements}) + (\#\text{ of Unique Element in Device})}$$

3. For each device or device concept under consideration list on a separate piece of paper the elements of the task as they would be trained on that device.

4. For each task element in the left column of Table 27 determine whether a device enables the trainee to practice that task element by examining the separate list of task elements for that device.

5. If the training device does allow practice of that operational task element, then enter a "1" in the appropriate cell for that device.

6. If the particular task element is not represented in the training device, either because the task is truncated or simplified, then enter a "0" in the appropriate cell.

7. Repeat this procedure for each task element of the training task.

8. Repeat the entire procedure for each training device or device concept under consideration.

9. For each training device or device concept under consideration, total the number of "1"s (i.e., the number of task elements for which the training device allows the trainee to actually practice the training task).

10. Enter the total number of "1"s for each device in Table 27.

11. Derive the task commonality index value by dividing the total number of "1"s by the total number of task elements in the training task plus the total number of task elements

unique to a device which are not related to the training requirements.* The number of elements unique to a device and not needed is included in the formula to reduce the final effectiveness score for those devices offering greater capability (and therefore cost more) than actually required.

A separate task commonality table is used for each task. How faithfully the element is represented in a training device is considered separately.

Physical Similarity--A physical similarity analysis is based on the physical similarity or fidelity of displays (cues) and controls (responses) in a training device relative to those in the operational equipment. The following procedure is applied to each task:

1. List the controls and displays involved in task performance down the left column of Table 28.

2. List the training devices or training device concepts to be assessed across the top of Table 28.

3. For each control or display listed in the left column of Table 28, rate how well it is physically represented in each training device or device concept under consideration. Base your ratings of physical similarity on the four-point scale given in Table 29.

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*In some cases, additional elements which aid training may be present (for example, augmented feedback). The present use of "unique" element does not include these training-related extra elements. If extra elements are present which enhance training of the required task, these should be noted for later reference in overall evaluation of the device concept.

TABLE 28. PHYSICAL SIMILARITY ANALYSIS

NAME OF TASK ______________________________

REQUIRED TASK CONTROLS AND DISPLAYS	DEVICE A	DEVICE B	DEVICE C
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Sum of Physical Similarity Ratings			
Physical Similarity Index			

$$\text{Physical Similarity Index} = \frac{\text{Sum of Similarity Ratings for Device}}{3(\#\text{ of Rq'd Cont. \& Displays}) + (\#\text{ of Controls \& Displays Unique to Device})}$$

TABLE 29. PHYSICAL SIMILARITY RATING SCALE

Rating	Definition
3	Identical. The trainee would not notice a difference between the training device control or display and the operational control or display when he moves from the training to the job situation. Include for consideration the location, appearance, feel, and any other physical characteristics. Ignore the amount and quality of information transmitted.
2	Similar. There would be a small noticeable difference for the trainee between the training device control or display and the operational control or display, but he would be able to perform the task. There might be a decrement in performance, but any such decrement would be small and readily overcome.
1	Dissimilar. There would be a large noticeable difference quite apparent to the trainee, between the training device control or display and the operational control or display and a large performance decrement, given that the trainee could perform at all. Specific instruction and practice would be required on the operational equipment after practice on the training device to overcome the decrement.
0	Missing. The control or display is not represented at all in the training device.

4. Repeat the procedure for each training device or training device concept under consideration.

5. For each training device or device concept under consideration add the ratings for each control and display listed to obtain a total score.

6. Enter the total score for each device in Table 28.

7. Total the number of controls and displays unique to a device or device concept in addition to the required set of controls and displays. These are controls and displays unrelated to the training requirements (see previous footnote).

8. Derive the physical similarity index value by dividing the sum of physical similarity ratings by three times the number of controls and displays plus the number of controls and displays unique to a device or device concept.

9. Enter the physical similarity index value in Table 28.

A separate physical similarity table is used for each task. How faithfully the training device represents the functioning of the operational equipment is considered below.

Functional Similarity--The functional similarity analysis compares the operator's behavior in terms of the information flow from each display to the operator, and from the operator to each control. The assessment is made in terms of the amount of information transmitted from each display to each control and the type of information-processing activity performed by the operator. The issue is not the physical fidelity of a

control or display, but whether the operator acts on the same amount of information in the same way in both operational and training situations.

Controls and displays are considered in conjunction with task elements to determine the type, amount, and direction of information flow occurring during task performance. Each situation in which a display transmits information to the operator (e.g., reads it) is defined as a stimulus function, while each situation in which the operator transmits information to a control (e.g., operates it) is termed a response function.

In each, the amount of information may be estimated by the number of states or discrete values which the display or control may assume. The functional similarity is assessed by comparing the number of discrete values or states in the training situation to the corresponding number in the operational situation. The range of values may be partitioned into four major levels: 1) continuous (essentially unlimited), 2) multivalued (some discrete value greater than two), 3) binary (two values), or 4) not represented. Table 30 is used in performing functional similarity analyses.

1. List the controls and displays involved in task performance on the operational equipment down the left column of Table 30.

2. List the training devices or training device concepts to be assessed across the top of Table 30.

3. For each control or display listed in the left column of Table 30 note how well it is functionally represented in each training device under consideration. Base your ratings of functional similarity on the four-point scale given in Table 31.

TABLE 30. FUNCTIONAL SIMILARITY ANA

NAME OF TASK ____________________

REQUIRED TASK CONTROLS AND DISPLAYS	DEVICE A	DEVICE B
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
Sum of Functional Similarity Ratings		
Functional Similarity Index		

Functional Similarity Index = Sum of Similarity Ratings for Device / 3(# of Rq'd Controls & Displays) + (# of Controls & Displays

TABLE 31. FUNCTIONAL SIMILARITY RATING SCALE

Rating	Definition
3	Identical. The number of states in the training situation is the same as the number of states in the operational setting.
2	Similar. The number of states in the training situation is at least half of the number of states in the operational setting.
1	Dissimilar. The number of states in the training situation is less than half of the number of states in the operational setting.
0	Missing. The control or display is not represented at all in the training device.

4. Repeat the procedure for each training device or training device concept under consideration.

5. For each training device or device concept under consideration add the ratings for each control and display listed to obtain a total score.

6. Enter the total score for each device in Table 30.

7. Total the number of controls and displays unique to a device or device concept in addition to the required set of controls and displays, if any such controls or displays exist (see previous footnote).

8. Derive the functional similarity index value by dividing the sum of functional similarity ratings by three times the number of controls and displays plus the number of controls and displays unique to a device or device concept.

9. Enter the functional similarity index value in Table 30.

A separate functional similarity table is used for each task.

Skills and Knowledges Requirements--This analysis assesses the skills and knowledges in the student's repertory before training and compares them to the skills and knowledges required for successful performance of the training tasks. Table 32 is used in performing this analysis.

1. List the skills and knowledges required for successful task performance down the left column of Table 32.

Table 32. Skill and Knowledge Requirements Analysis.

NAME OF TASK ______________________

REQUIRED TASK SKILLS AND KNOWLEDGE	AFTER TRAINING	BEFORE TRAINING	DIFFERENCE (AFTER – BEFORE)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Difference Score			
Skill & Knowledge Requirements Index			

Skill & Knowledge Requirements Index = $\frac{\text{Total Difference Score}}{4\ (\text{Number of Skills \& Knowledge})}$

2. For each skill or knowledge listed in the left column of Table 32, estimate how "much" of the skill or knowledge the average trainee could be expected to have upon first exposure to the training device, and estimate how much of the skill and knowledge he must possess at training's completion. Use the two scales in Tables 33 and 34.

3. Compute the differences between skill and knowledge requirements before and after training by subtracting the before-training value from the after-training value for each skill or knowledge. (Negative differences are set equal to zero, because they indicate the trainee enters with more skill than necessary).

4. Add the difference scores ("after" minus "before" ratings) for the skills and knowledges listed to obtain a total difference score.

5. Enter the total difference score for each device in Table 32.

6. Derive the skill and knowledge requirements index by dividing the total difference score by four times the number of skills and knowledges.

7. Enter the skill and knowledge requirements index value in Table 32.

A separate skill and knowledge requirements table is used for each task.

Task Training Difficulty--A task training difficulty analysis estimates the difficulty (in terms of training time) of training soldiers to successfully

TABLE 33. RATING SCALE FOR SKILLS AND KNOWLEDGES BEFORE TRAINING

Rating	Definition
4	Has a complete understanding of the subject or skill. Can do the task completely and accurately without supervision. Has received "skill" training.
3	Understands the subject or skill to be performed. Has applied part of the knowledge or skill either on the actual job or a trainer. Has done the job enough times to make sure he can do it, although perhaps only with close supervision. Has had "procedural" training.
2	Has received a complete briefing on the subject or skill. Can use the knowledge or skill only if assisted in every step of the operation. Requires much more training and experience. Has received "familiarization" training only.
1	Has only limited knowledge of this subject or skill. Has not actually used the information or skill. Cannot be expected to perform. Has had "orientation" only.
0	No experience, training, familiarity, etc., with this skill or knowledge. Cannot perform a task requiring this skill or knowledge.

TABLE 34. RATING SCALE FOR SKILLS AND KNOWLEDGES AFTER TRAINING

Rating	Definition
4	Should have a complete understanding of the subject or be highly skilled. Is able to perform the task completely, accurately, and independently. Has had "skill" training.
3	Should have an understanding of the subject or skill to be performed. Has applied part of the knowledge or skill on the actual job or a trainer. Has done the job enough times to make sure he can do it although perhaps only with close supervision. Needs more practice under supervision. Has had "procedural" training.
2	Should have received a complete briefing on the subject or task. Is able to use the knowledge or skill only if assisted in every step of the operation. Requires much more training and experience to be able to perform the task independently. Has had "familiarization" training.
1	Should have limited knowledge of the subject or skill. Has not actually used the information. Is not expected to perform the task. Has completed "orientation" training.
0	At the end of training, the trainee should have no experience or training.

that training occurs on the operational equipment. Use Table 35 in performing this analysis.

1. List the task elements down the left column of Table 35.

2. For each task element listed, rate the amount of training time for surmounting its associated deficit relative to the most time-consuming task element. Table 36 is used.

3. Add the training difficulty ratings for the task elements listed to obtain a total training difficulty score.

4. Enter the total training difficulty score in Table 35.

5. Derive the task training difficulty index by dividing the total training difficulty score by four times the number of task elements.

6. Enter the task training difficulty index value in Table 35.

A separate task training difficulty table is used for each task; however, the rating scale is used by evaluating training time for each task element relative to the most time-consuming element for <u>all tasks in the current analysis</u>.

<u>Index of Training Device Effectiveness</u>--The five analyses just completed are used to derive overall indexes of effectiveness for each training device or training device concept under consideration.

- Task commonality
- Physical similarity
- Functional similarity

TABLE 35. TASK TRAINING DIFFICULTY ANALYSIS

NAME OF TASK ____________________

REQUIRED TASK ELEMENT	TRAINING DIFFICULTY
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Total Training Difficulty Score	
Task Training Difficulty Index = $\frac{\text{Total Training Difficulty Score}}{4(\text{Number of Task Elements})}$	

TABLE 36. TASK TRAINING DIFFICULTY RATING SCALE

Rating	Definition
4	Requires as much time to train as the most time-consuming task element, considering all task elements for all tasks in the current analysis
3	Requires substantial training time, but less than above
2	Requires a moderate amount of training time relative to the most time-consuming task element
1	Requires only minimal training time relative to the most time-consuming task element
0	Requires no training time

- Skill and knowledge requirements
- Task training difficulty

The task commonality, physical similarity, and functional similarity analyses were conducted on a task-by-task basis for each training device or training device concept. The skill and knowledge requirements and task training difficulty analyses were independent of any particular device and addressed specific personnel and training requirements. The following procedure is used to derive task level training effectiveness indexes.

1. List the tasks requiring training down left column of Table 37.
2. Obtain task commonality, physical similarity, and functional similarity index values derived in previous analyses (Tables 27, 28, and 30) for each task listed in Table 37.
3. Enter these values in the appropriate columns of Table 37.
4. For each task, add the listed task commonality, physical similarity, and functional similarity scores and divide by three. The obtained value indicates the degree of correspondence between the operational equipment and the particular training device for that task.
5. Repeat this analysis for each training device.

TABLE 37. TRAINING DEVICE AND OPERATIONAL EQUIPMENT TASK LEVEL CORRESPONDENCE

NAME OF DEVICE ______________________

REQUIRED TASKS	TASK COMMONALITY (TC)	PHYSICAL SIMILARITY (PS)	FUNCTIONAL SIMILARITY (FS)	$\frac{TC + PS + FS}{3}$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

The next analysis summarizes the personnel and training requirements analyses.

1. List the tasks requiring training down the left column of Table 38.

2. Obtain the skill and knowledge requirements and task training difficulty index values derived in previous analyses (Tables 32 and 35) for each task listed in Table 38.

3. Enter these values in the appropriate columns of Table 38.

4. For each task, add the listed skill and knowledge requirements and task training difficulty index values and divide by two. The obtained value indicates the extent of training required based on skills and knowledge requirements and abilities of the typical trainee.

The final analysis derives overall training device effectiveness indexes for each device or device concept by combining the task level training device and operational equipment correspondence analysis and the task level personnel and training requirements analysis.

1. List the tasks requiring training down the left column of Table 39.

2. List the training devices or training device concepts to be assessed across the top of Table 39.

3. Obtain the $\frac{TC+PS+FS}{3}$ and $\frac{SKR+TTD}{2}$ values for each task and for for each training device from Tables 37 and 38 and enter them in the appropriate columns of Table 39.

TABLE 38. TASK LEVEL PERSONNEL AND TRAINING REQUIREMENTS

NAME OF DEVICE ______________________________

TASKS	SKILL & KNOWLEDGE REQUIREMENTS (SKR)	TASK TRAINING DIFFICULTY (TTD)	$\frac{SKR + TTD}{2}$
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Table 39. Example Training Device Effectiveness Index.

TASKS	DEVICE A			DEVICE B			DEVICE C		
	$\frac{TC+PS+FS}{3}$	$\frac{SKR+TTD}{2}$	PRODUCT	$\frac{TC+PS+FS}{3}$	$\frac{SKR+TTD}{2}$	PRODUCT	$\frac{TC+PS+FS}{3}$	$\frac{SKR+TTD}{2}$	PRODUCT
1. Fire Main Gun	.65	.79	.51	.82	.79	.65	.92	.79	.73
2. Adjust Fire	.43	.80	.34	.70	.80	.56	.82	.80	.66
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
(A) Sum of Products			.85			1.21			1.39
(B) Sum of $\frac{SKR+TTD}{2}$		1.59			1.59			1.59	
Training Device Effectiveness Index	.53			.76			.87		

$$\text{Training Device Effectiveness Index} = \frac{A}{B} \times \frac{\text{\# of Required Tasks}}{(\text{\# of Rq'd Tasks}) + (\text{\# of Tasks Unique to Alternative Device Concept})}$$

4. Multiply the $\frac{TC + PS + FS}{3}$ and $\frac{SKR + TTD}{2}$ values for each task and enter in the appropriate column labeled product.

5. Add the product values for all tasks and enter the sum in the sum of products location for that device.

6. Add the $\frac{SKR + TTD}{2}$ values for each task and enter the sum in the sum of $\frac{SKR + TTD}{2}$ location for that device.

7. Divide the value from Step 5 ("A") by the value from Step 6 ("B"). This value is the training device effectiveness index for that training device concept.

8. When comparing alternative existing device concepts, an effectiveness index is adjusted by multiplying it by:

$$\frac{\text{\# of Required Tasks}}{(\text{\# of Required Tasks}) + (\text{\# of Tasks Unique to the Alternative})}$$

This factor accounts for capabilities within an existing device that are not required for the device under consideration. Capabilities not required mean additional cost, and this correction factor adjusts the effectiveness score to reflect a loss of effectiveness due to unnecessary cost. Where a theoretical device concept is being considered, there probably will be no tasks unique to it and the correction factor is not used.

9. Repeat the procedure for each training device or training device concept under consideration.

The training device effectiveness index will take on a value of "1" if there is a perfect correspondence between the training device and the operational equipment. The effectiveness index will take on a value of "0" when there is no correspondence between the device and the operational equipment.

Example of Training Device Concept Formulation

The following example illustrates application of the procedures for comparing alternative training device concepts. Three devices are compared. For purposes of this example assume that devices A and B are existing devices and device C is a theoretical training device concept. Two task training requirements (Table 40) are included in this example. Task commonality (Tables 41 and 42), physical similarity (Tables 43 and 44) and functional similarity (Tables 45 and 46) analyses are performed for each device for each task. Skill and knowledge requirements (Tables 47 and 48) and task training difficulty (Tables 49 and 50) analyses are performed for each task. Adjustments are made for task elements, controls, and displays unique to each existing device. Tables 51 through 55 compute effectiveness scores for each device. The effectiveness score for device C is the highest. Therefore, the theoretical device concept should be developed further. The effectiveness score for device B, an already existing device, is lower; however, its score is sufficiently high to conduct further evaluation. Using an existing device may result in cost savings that would compensate for its lower effectiveness score. Validation testing could be used to determine whether device B or device C is more appropriate.

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APPENDIX H

TRAINING CONCEPT DESCRIPTIONS*

* Taken from TRADOC Training Effectiveness Analysis Handbook, Appendix 1.

General

SECTION 2 - INSTITUTIONAL TRAINING CONCEPT

The data required to develop the institutional training costs (ITC) are listed below. This format is provided to facilitate the definitional process required to develop costs for institutional training concepts or courses of instruction. The requirements herein should be completed for each alternative concept under consideration and for each course impacted.

1.0 Course(s) Impacted

1.1 Modification or New Course

1.2 Describe Changes to Current Courses of Instruction

2.0 Student Load Per Class Per Year

2.1 Average Grade of Student

2.2 Student Source

3.0 Class Frequency Per Year

3.1 Length of Class

3.2 Fiscal Year of Course Start

4.0 Instructor Requirements Per Affected Subcourse(s)

5.0 Support Personnel Requirements

6.0 Expended Equipment Per Class (Subcourse)

7.0 Non-expended Equipment Used and Usage Rate Per Subcourse

8.0 Exportable Training Used

8.1 Exportable Software

8.2 Training Teams

8.3 Exportable Hardware

9.0 Facility Requirements

Example

An outline and an example of a hypothetical institutional training concept is shown below.

SAMPLE: INSTITUTIONAL TRAINING CONCEPT (HYPOTHETICAL)

Training Device - X99 Mortar Crew Trainer (MCT)

1.0 Course(s) Impacted

The X99 MCT will be utilized in the 11C10 course.

1.1 Modification or New Course

This concept will modify the current course.

1.2 Describe Changes to Current Course of Instruction

The current live fire crew drill subcourse will be replaced by instruction of the X99 MCT. This will reduce the time required for this subcourse and will reduce the total rounds fired and personnel support requirements.

2.0 Student Load Per Class Per Year

Year				
1	2	3	. . . . .	20
50	40	30		30

2.1 Average Grade of Student

The average class consists of 10 percent E3, 80 percent E2, and 10 percent E1; therefore, the average grade of students is E2.

2.2 Student Source

Students in the 11C10 course are in AIT phase of OSUT.

3.0 Class Frequency Per Year

Year			
1	2	3	20
20	17	12	12

3.1 Length of Class

	Current	Modified
Full Course	10 weeks	9 weeks
Crew Drill Subcourse	3 weeks	2 weeks

3.2 Fiscal Year of Course Start

The modified 11C10 course utilizing the X99 MCT will be feasible in FY 87.

4.0 Instructor Requirments Per Affected Subcourse(s)

Crew Drill subcourse instructors per Class:

	Current	Modified
11C40 E7	160 Manhours	110 Manhours
11C30 E6	160 Manhours	110 Manhours
11B 03	80 Manhours	50 Manhours
11B 04	80 Manhours	50 Manhours

5.0 Support Personnel Requirements

The modified subcourse will require no support personnel; however, since the simulated crew drill replaces several live fire exercises, the following personnel, currently required, will be freed for other purposes:

	Current Per Class
11C30 E6	480 Manhours
11C20 E5	960 Manhours
11C20 E4	1920 Manhours

6.0 Expended Equipment Per Class (Subcourse)

	Current	Modified
Cartridge M374	800 (250)	550 (0)
Cartridge M57	200 (25)	175 (0)
Cartridge M301	50 (0)	50 (0)
Cartridge M362	85 (5)	80 (0)
Cartridge M375	100 (100)	0 (0)
Soldiers Manual 11C	50	50

7.0 Non-expended Equipment Used Per Subcourse

	Current	Modified
M151 1/4 T	160 miles	10 miles
26 Passenger Bus	320 miles	20 miles
M29A1 Mortar	380 RDS	0 RDS
M35 2 1/2 T	160 miles	0 miles
PU-619 Gen	80 hours	0 hours

Instructors Manual 11C	10	10
Instructors Manual X99	0	10

8.0 Exportable Training Used

None

8.1 Exportable Software

None. (This would be applicable to training packages sent to the field such as manuals, training films, circulars, bulletins, cassettes, etc.)

8.2 Training Teams

None. (If teams are sent from the institution to the units to provide training on new equipment, doctrine, or tactics, this section will reflect team composition, schedule, units trained, personnel trained, and assets utilized during training.)

8.3 Exportable Hardware

None. (This section will describe quantities and types of hardware to be provided to units by institutions to support training requirements for the alternative.)

9.0 Facility Requirements

	Classroom	Ranges
Institution	3000 Sq Ft*	
	Permanent brick	None
Unit	None	None

*2,000 Sq Ft exist; 1,000 Sq Ft require construction.

SECTION 3 - UNIT TRAINING CONCEPT

General

The unit training concept should also be defined by the proponent and is outlined below. This format is provided as a means of capturing pertinent unit training factors for use in calculating training costs. The outline herein should be used to define a generic unit training routine for each training alternative of interest.

1.0 Training Alternatives

2.0 Training Events (This section to be completed for each Generic Training Event)

2.1.1 Training Event #1 (Title, Soldiers Manual, or ARTE Reference)

2.1.2 Description of Training Conducted

2.1.3 Level of Training Aggregation (Squad, Plt, Bn, Division)

2.1.4 Instructor Personnel Required and Parent Unit (Organic to Level of Training Conducted)

2.1.5 Personnel Trained (Quantity, Grade, MOS)

2.1.6 Location of Training, Distance from Unit Area, Means of Transportation

2.1.7 Equipment Utilized and Rate Per Event (Miles, Hours, etc.)

2.1.8 Facility Requirements (Classrooms, Ranges, Motor Pool Buildings, etc.)

2.1.9 Time Requirements Per Training Event

2.1.10 Frequency of Training Event Repetition (Times Per Month, Quarter, or Year)

2.1.11 Support Personnel and Equipment Requirements (Personnel Other than Students and Instructors)

2.1.12 TDY Requirements for Training Event #1

2.2.1 Training Event #2 (Title)

2.2.2 Description of Training Conducted

.

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2.N.12 TDY Requirements for Training Event #N

Example

The following is an example of a hypothetical unit training concept.

SAMPLE: <u>UNIT TRAINING CONCEPT</u> (HYPOTHETICAL)

1.0 Training Alternative

The unit training concept definition is the program which is anticipated to be used with the intensified simulation training for REDEYE gunners (hypothetical).

2.0 Training Events #1 through #15

2.1.1 Training Event #1

Engage Hostile Aircraft; Task 1057, FM 44-16P

2.1.2 Description of Training Conducted

Gunners engage simulated hostile aircraft in a combat environment utilizing the moving target simulator (MTS). Each gunner will track 25 aircraft, scoring simulated hits on no fewer than 80 percent of engageable targets.

2.1.3 Level of Training Aggregation

Training event will be conducted at the REDEYE section level for each battalion.

2.1.4 Instructor Personnel Required and Parent Unit

Instructors will be those organic to the local or supporting MTS and will not be part of the unit trained. In general, the instructor requirements will consist of one E6 16P30 per section trained.

2.1.5 Personnel Trained (per battalion)

16P10, E4, 5 each

2.1.6 Location of Training, Distance from Unit Area, Means of Transportation

MTS facilities are located in each major troop concentration geographic area such as Ft Hood, Ft Riley, Ft Bragg, Ft Bliss, 7th Army ATC, Ft Lewis, and Camp Casey. The average REDEYE section would be required to travel approximately 75 miles one-way to reach the MTS facility. Organic section vehicles would be used to and from the MTS.

2.1.7 Equipment Utilized and Rate Per Event

MTS	8 Hours Per Event
Tracking Head Trainer	16 Hours
1/4T Truck	300 Miles Per Event

2.1.8 Facility Requirements

MTS Screen

2.1.9 Time Requirements Per Training Event

8 Hours Per Section

2.1.10 Frequency of Training Repetition

The engagement simulation training will be conducted at least monthly for each REDEYE section or 12 times annually for each gunner.

2.1.11 *Support Personnel and Equipment Requirements*

GS-9	Electronics Technician	3 Hours Per Training Event

2.1.12 TDY Requirements Per Training Event #1

Three REDEYE sections are located in isolated areas from the nearest MTS facility and will require three days per diem pay for each training event plus commercial air transportation costs of approximately $135 per man per event.

2.2.1 Training Event #2

Visual aircraft recognition; Task 1040, FM 44-16P

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-
-
-

2.N.10 Frequency of Training Event Repetition

Task 1061, determination of aircraft category for REDEYE ranging will be conducted weekly per section using the modified GOAR kit.

-
-
-
-
-

2.N.12 TDY Requirements Per Training Event #N

None

SECTION 4 - TRAINING SYSTEM REQUIREMENTS SPECIFICATION (TSRS)

General

This format is provided to facilitate the definitional process required to develop costs for training devices or systems. It is intended as a means of standardizing required input to preclude both too little and too detailed input.

1.0 Hardware Description

1.1 Physical Characteristics (dimensions, weight, space requirements)

1.1.1 Functional Characteristics (task flow, operating layout, input/output description)

1.2 Power Requirements (kw/hr, volts, ac/dc)

1.3 Calibration Requirements (level, location, frequency)

1.4 Maintenance hours per unit of operation (hr/yr, hr/mile, hr/round, etc.)

1.4.1 Maintenance Level and Location

1.5 Depot Overhaul Frequency (overhauls/time period)

1.6 Computer Requirments

1.6.1 Type (general or specialized, time share of dedicated, available or required)

1.6.2 Storage Capacity (main core and peripheral)

1.6.3 Compiler (available or not available)

1.6.4 Word Size (bits per word)

1.6.5 Software Requirements

1.7 Hardware Replaced and Replacement Ratio

1.8 Personnel Replaced

1.9 Projected Operational Life

2.0 Employment Concept

2.1 Annual Operating Factor (hours, miles, rounds, use per training event/frequency of events)

2.2 Operators Required (grade, MOS, quantity)

2.3 Level of Use

2.3.1 Institutional (BCT, AIT, NCOES, OBC, AOC, etc.)

2.3.2 Unit (individual, squad, platoon, etc.)

2.4 Basis of Issue

2.4.1 Institutions

2.4.2 Units (Active and Reserve)

2.5 Float Requirement Ratio (float devices per each operational device)

The TSRS provides the minimum information required about the system before cost analysis can take place. The source of this information would primarily be the proponent with assistance from DARCOM. The general intent of the TSRS is to define the system in such detail as to a allow the analyst to define and direct his cost effort.

Example

An outline and example of a hypothetical TSRS is shown below.

SAMPLE: <u>TRAINING SYSTEM REQUIREMENTS SPECIFICATION (HYPOTHETICAL)</u>

SYSTEM: Fire Control Simulator BT33

1.0 Hardware Description

1.1 Physical Characteristics

Screen Size: 6m x 1.5m

Central Unit: 4m x 1m x 1.5m

Slide Projectors: .5m x .5m .2m; 8mm (4 ea)

Space Requirements: 3000 sq ft classroom

Student Capacity: 50

1.1.1 Functional Characteristics

The BT33 simulates artillery fire and adjustment of fires on stationary and moving targets. The battlefield panorama including the target area is projected on the screen with a slide projector. The observer (students) can see the projected area from the simulated OP. The instructor indicates the target display projector. The students observe the target and, using simulated communications procedures, make inputs to the device operator (simulated fire distribution center). The operator inputs data to implement the student's calls for fire. The central unit calculates the position of the bursts in the furtherest area and projects the burst symbols onto the screen with the burst projectors. The student may then adjust fire, lift fire, increase fire, or report damage assessment.

1.2 Power Requirements

220 VAC, 50-60 Hz, 1 kw/hr

1.3 Calibration Requirements

System is aligned quarterly, total manpower requirements equal one manhour per quarter. Calibration performed by local unit at user location, level c.

1.4 Maintenance Hours Per Unit of Operation

The BT33 required an average of one hour of direct maintenance for every 40 hours of operation

1.4.1 Maintenance Level and Location

Organizational, DS, and GS maintenance are authroized to be conducted by the qualified operator on station.

1.5 Depot Overhaul Frequency

The BT33 will require depot overhaul every 10 years. Depot overhaul will require the BT33 to be transported to Red River Depot, Texas.

1.6 Computer Requirements

1.6.1 Type

Specialized. The BT33 is complete with its own processing unit which is dedicated.

1.6.2 Storage Capacity

The core memory will store 4,096 words, each containing 16 bits.

1.6.3 Compilers

None

1.6.4 Word Size

16 bits

1.6.5 Software Requirements

The BT33 contains 8mm film cassettes to simulate targets plus pre-programmed fire mission commands controlled by the operator console.

1.7 Hardware Replaced and Replacement Ratio

In the institutional environment the BT33 will replace four puffboards (terrain mock-ups) and possibly replace live fire exercises if no effectiveness degradation results. The replacement of the puffboard will enhance realism while the replacement of the live fire exercises could result in cost savings.

1.8 Personnel Replaced

None

1.9 Projected Operational Life

Twenty years with one depot overhaul.

2.0 Employment Concept

2.1 Annual Operating Factor

Institution: (24 hr per week - 52 weeks) 1,248 hr per year

Unit: (80 hr per month - 12 months) 960 hr per year

2.2 Operators Required

One per device minimum

Institution: E7 13E40

Unit: 03 13F

2.3 Level of Use

2.3.1 Institutional

OBC, Advanced NCOES (13E)

2.3.2 Unit

DIVARTY FIST; maneuver unit leaders courses

2.4 Basis of Issue

2.4.1 Institutional

USAFAS: 2

2.4.2 Units

2.5 Float Requirement Ratio

SECTION 5 - LIFE CYCLE COST ESTIMATE (LCCE).

The LCCE considers all costs incurred during the projected life of the training system and/or subsystem. The LCCE includes the cost to acquire, operate, and maintain the training hardware (device) over its useful life. Materiel system life cycle cost includes all costs associated with the three life cycle phases: research and development (R&D), investment, and operations. Depicted in Figure I-1 is a profile of the life cycle of a materiel system and cost phases.

APPENDIX I

HRTES PROCEDURES FOR IDENTIFYING OT TEST ISSUES

This appendix describes HRTES procedures for developing OT test issues. The description of these procedures was taken from the HRTES Prototype Handbook, pages 123 to 175.

HUMAN PERFORMANCE MEASURES

In this section, you will identify the performance measures to take during the operational test. Read the general section on performance measures (time and accuracy). These will reference the human performance functions you gathered from section 6. After completing this section you should have developed specific measures of human performance which can be used in the operational test.

NEXT: Turn to Test Conditions page I-13).

HUMAN PERFORMANCE MEASURE 1

TIME-DURATION OF HUMAN PERFORMANCE FUNCTION

RATIONALE

This is the measure of the length of time between the presentation of that cue which marks the initiation of a Human Performance Function (HPF) and the completion of that HPF, or the cessation of HPF behavior, in the absence of completion. This measure incorporates reaction time according to the nature of the HPF's measured in HRTES. If an HPF were "Target Detection", then the duration of that HPF would be identical to reaction time. Therefore, for the purposes of simplification and clarity, HPF's are so structured that duration is the only time measure required.

The length of time it takes to perform an HPF is important for two reasons:

(1) Many HPF's can only be accomplished successfully as a function of time. That is, if a given HPF were not completed within a specified period of time, it would, by definition, be considered a failure. In addition, the faster a given HPF were completed, the greater would be the level of its success.

(2) Comparable systems frequently have HPF's in common. Time to perform an HPF is one measure of the difficulty of that HPF. The larger the number of more difficult HPF's a given system requires, the less desirable is that system, all other factors being equal. Therefore, time to perform may be used to differentiate the relative desirabilities of competing systems.

METHODOLOGY

1. Identify the cue which initiates HPF behavior.

    1.1 In the first HPF of a series, this cue is normally the introduction of a new stimulus, such as:

        1.1.1 visual target
        1.1.2 auditory signal
        1.1.3 command

    1.2 In later HPF's in a series, the cue is often the completion of the previous HPF.

    1.3 Example - Target acquisition:

        1.3.1 target detection-presentation of target

        1.3.2 target identification-completion of identification or, in some cases, target-presentation

        1.3.3 target location-presentation of target

        1.3.4 aim/lock on-completion of target location

Frequently, the HPF's may not take place in as linear a manner as shown above. For the purpose of the OT, it is necessary that recordable initiation cues either be determined or be artificially introduced prior to the start of actual testing.

2. Determine the smallest time interval required for measurement of the given HPF.

   2.1 For HPF's which consist entirely of reaction to a presented stimulus, one tenth of a second is the smallest time interval required, unless otherwise stated.

   2.2 For HPF's which consist of motor behavior or some combination of motor and intellectual behavior, the smallest time interval will vary with the HPF. A reasonable rule of thumb is that the smallest time interval required is one-tenth of the interval used in stating the criterion.

3. Identify the incident which informs you that either the HPF has been completed, or that HPF behavior has ceased.

   3.1 In the case of HPF completion, the end point is defined in advance. Since this end point may be entirely intellectual and not observable, provisions may be required to aid in end point recognition.

      3.1.1 target detection - either operator switch closing, or vocal signal upon detection, depending on the amount of money and time available.

      3.1.2 target identification - vocal signal of the nature of the target, or prestructured switch coding indicating nature of target.

      3.1.3 target location - vocal signal of target coordinates, measured from initiation of vocal response.

3.1.4 weapon aiming - completion of each aiming incident, measured to completion - not initiation of aiming.

3.2 In the case of the cessation of HPF behavior, in the absence of completion, three general methods are available:

3.2.1 vocal signal

3.2.2 switch closing

3.2.3 observation - This is the most questionable technique, but in the confusion which often accompanies cessation without completion, it may be necessary to use this approach to avoid complete loss of data.

4. Select conditions in which HPF is to be run.

NOTE: It may be desirable to append the most important of these conditions directly to the selected SPI, thereby creating a composite SPI which emphasizes that condition. See appropriate Note accompanying the SPI's for further information on this subject.

4.1 There are ten classes of conditions:

4.1.1 weather

4.1.2 light

4.1.3 target

4.1.4 personnel

4.1.5 operational

4.1.6 ground surface

4.1.7 ground slope

4.1.8 obstacles/concealment

4.1.9 tactical

4.1.10 training

For a more detailed analyis of these classes of conditions, and a system for ranking them for criticality, see the Condition Ranking System on page

5. Determine the number of subjects to be run in the test to collect the measure.

6. Determine the number of trials to run per subject.

7. Determine the method for collecting the data.

7.1 There are three basic problems which impact the collection of data:

7.1.1 How much money is available?
7.1.2 How much time is available for preparation?
7.1.3 How much space is available in the system?

7.2 These three problems interact with each other. If neither space, time, nor money is a serious issue, it is best to:

7.2.1 include a trained observer with each system in the test
7.2.2 fully instrument each system in the test so that HPF cues indicating initiation and completion, as well as time measures, would be automatically recorded.

7.3 If there is no room for an observer, instrumentation is a firm requirement.

7.4 If there is room for an observer, but not sufficient funding for full instrumentation, it is best to train the observer as fully as possible.

7.5 If there is room but insufficient funding for full instrumentation, and insufficient time for complete observer training, it is best to select those individuals to be observers who are either experienced in operational testing, or who learn quickly and are adaptable.

7.6 One factor is clear: one must collect data. The more objective the method of collecting the data, the better quality it is likely to be. It is preferable to minimize reliance on operator reports for objective data collection. Therefore, systems to be investigated should be instrumented and/or supplied with observers.

HUMAN PERFORMANCE MEASURE 2

ACCURACY OF HUMAN PERFORMANCE FUNCTIONS

RATIONALE

This is a group of measures relating to the accuracy with which personnel carry out Human Performance Functions (HPF's). An HPF may be either omitted or performed. If it is performed, the accuracy of its performance is variable. Based on judgement, one point on this continuum may be selected as the lowest level of acceptable performance. This point becomes the criterion. All performance superior to the criterion is desirable, but may cost more to achieve than is warranted by system requirements. All performance inferior to the criterion is undesirable, and that undesirability increases as the level of accuracy decreases.

Determination of HPF accuracy serves three functions:

(1) Analysis of System Performance: It provides important data for the analysis of total system performance, leading to an understanding of the reasons that a system has not achieved all expected performance criteria.

(2) Analysis of Human Performance: It provides data leading to an understanding of the bases of human performance inaccuracy and the steps needed to reduce that inaccuracy.

(3) Human Performance Reliability: It provides data required for the eventual projection of human performance reliability in system operation.

METHODOLOGY

1. Determine the criticality of the problem in question.

1.1 It would be desirable if there were some objective method for determining the criticality of problems. Unfortunately, this can be done only through the use of judgment. It is clear that some problems are more critical than are others, and that this difference may provide some increased meaning to the output of the OT. The following rating scale can be photocopies and given to appropriate individuals to aid in the determination of problem criticality.

What effect would this problem have on performance of the HPF?

0 = No effect on performance
1
2
3 = HPF can be performed but has been moderately affected
4
5
6 = HPF cannot be performed adequately

It is desirable to have problem criticality rated by both a user in a job classification equivalent to that of the individual involved in the problem and by an individual in the position immediately supervisorial to the former.

2. Identify measures which apply, in varying degree, to each HPF task.

NOTE: Each accuracy measure type is referenced by the appropriate problems listed on the Human Performance Charts.

2.1 Measures of HPF accuracy deal with

(1) problems in performance
(2) performance effectiveness
(3) effects of inadequate performance. They include evaluative measures which are applicable to other HPF measure areas and will be so noted.

2.1.1 number of problems/deviations from accurate performance
2.1.2 size of problems/deviations
2.1.3 direction of problems/deviations

NOTE: The following 4 measures include omissions, sequence problems, and accidents with accuracy measures:

2.1.4 system downtime due to all problems
2.1.5 percentage of HPF's run without problems
2.1.6 percentage of subcriterion trials of HPF's
2.1.7 number of repetitions required to perform HPF to criterion

2.2 Measures of omission refer to the absence of either an entire HPF, or one or more of its elements. Elements are those finer pieces of behavior which are performed to carry out the HPF.

2.2.1 number of HPF's totally omitted for a given System Performance Issue
2.2.2 number of HPF elements omitted for a given HPF
2.2.3 number of omitted HPF elements for a given HPF by category:

2.2.3.1 cueing elements
2.2.3.2 perception elements
2.2.3.3 cognitive elements
2.2.3.4 motor elements

2.3 Measures of sequence refer to the order in which HPF's and HPF elements are performed. In some cases, sequence is a very important measure, but in others it will be either meaningless or essentially impossible to collect. If you are considering collecting sequence measures, carefully consider if there really is a specific sequence in which the HPF or its elements are to be performed.

2.3.1 number of HPF's performed out of sequence (percentage of HPF's performed out of sequence for a given System Performance Issue is also useful)

2.3.2 number of HPF elements, for a given HPF, performed out of sequence (percentage of HPF elements performed out of sequence is also useful)

2.3.3 direction of sequence shift

2.3.4 number and sequence shift of HPF elements by category:

2.3.4.1 cueing elements
2.3.4.2 perception elements
2.3.4.3 cognitive elements
2.3.4.4 motor elements

2.4 Measures of accidents refer to both personnel and equipment accidents. Accidents to personnel need not involve injury. They do involve occurrences which lead to injuries. Accidents to materiel need not involve damage. They involve incidents such as dropping, striking, hitting, etc., which could be expected to produce damage. Critical incidents are those occurrences in which neither a personnel nor materiel accident takes place, but in which such an accident almost takes place.

2.4.1 number of accidents associated with HPF (personnel and materiel)

2.4.2 number of injuries associated with HPF

2.4.3 number of man-hours lost, associated with HPF

2.4.4 number of materiel accidents resulting in damage, associated with HPF

2.4.5 cost of replacement/repair of materiel involved in accident associated with HPF

2.4.6 number of man-hours lost due to materiel accident associated with HPF

2.4.7 number of critical incidents for personnel and for materiel associated with HPF

3. Select conditions in which HPF is to be conducted.

NOTE: It may be desirable to append the most important of these conditions directly to the selected SPI, thereby creating a composite SPI which emphasizes that condition. See appropriate Note accompanying the SPI's for further information on this subject.

3.1 There are ten classes of conditions:

3.1.1 training
3.1.2 weather
3.1.3 light
3.1.4 ground surface
3.1.5 ground slope
3.1.6 obstacles/concealment
3.1.7 target
3.1.8 personnel
3.1.9 operational
3.1.10 tactical

For a more detailed analysis of these classes and a system for ranking them, see the Condition Ranking System on page .

3.2 It is assumed that OT will exercise the system under optimum versions of probable conditions. It is also desirable for probable worst case conditions to be exercised in OT. If one or more of the conditions has been selected for inclusion in the System Performance Issue, one should still examine the others. Inclusion of a condition directly into a System Performance Issue does not mean that no other condition is applied; it means that this condition is of preeminent importance and must be tested.

4. Determine the method for collecting the data.

4.1 There are three general methods for collecting data:

4.1.1 observation
4.1.2 instrumentation
4.1.3 debriefing

4.2 Observation requires an observer who has some level of training and space/time in which to work, as well as some sort of structured data collection form.

4.3 Instrumentation requires an understanding of the nature of the data to be collected, a piece of appropriate performance measuring equipment, a means for activating it at the right times, a power source, and a place to put it. Debriefing requires a subject with some information, a structured debriefing form, a place/time for the debriefing and, in some cases, a debriefing individual who has some experience and/or ability in the area.

4.4 There are three basic problems which impact the collection of data:

4.4.1 How much money is available?
4.4.2 How much time for preparation is available?
4.4.3 How much space, in the system, is available?

4.5 These three problems interact with each other. If neither space, time, nor money is a serious issue, it is best to:

4.5.1 include a trained observer with each system in the test

4.5.2 fully instrument each system in the test so that HPF cues indicating initiation and completion, as well as time measures, would be automatically recorded.

4.6 If there is no room for an observer, instrumentation is a firm requirement.

4.7 If there is room for an observer, but not sufficient funding for full instrumentation, it is best to train the observer as fully as possible.

4.8 If there is room, but neither sufficient funding for full instrumentation nor sufficient time for complete observer training, it is best to select those individuals to be observers who are either experienced in operational testing or who learn quickly and are adaptable.

4.9 It is necessary that observers/instrumentation be so placed and trained that they are able to record the following sorts of information about HPF behavior:

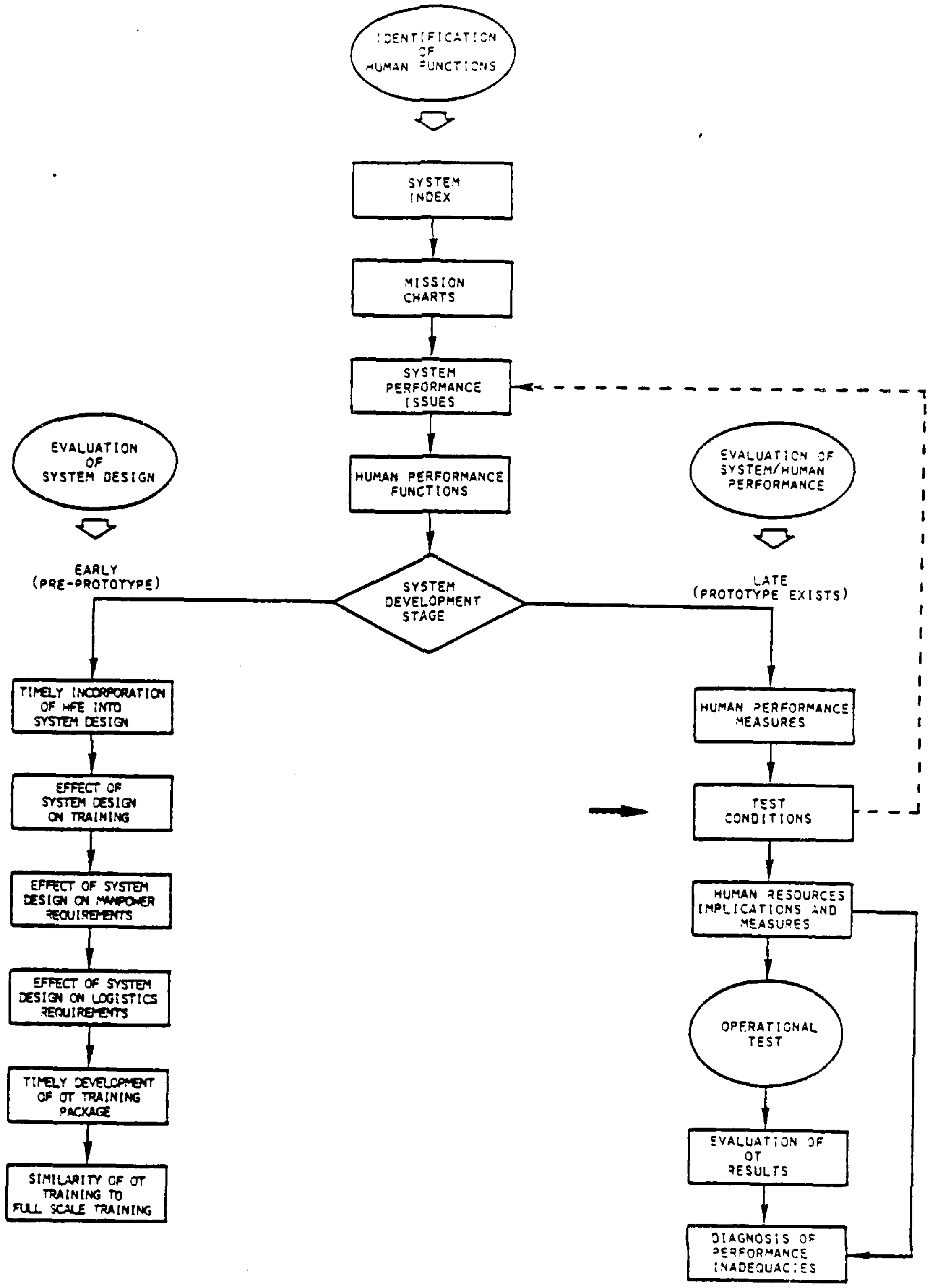
4.9.1 What was the cueing stimulus? Did either incorrect cueing, too general a cueing stimulus, too heavily stressed an operator, or lack of operator knowledge cause the HPF to be inaccurately performed?

4.9.2 Was HPF inaccuracy due to the operator's misperception of either the environment or the components of the system?

4.9.3 Did HPF inaccuracy originate in operator cognitive processes?

4.9.4 Did HPF inaccuracy originate in the operator's ability to apply his motor skills to the system, as designed? That is, was the operator unable to manipulate the system to accurately perform the HPF?

5. To maximize measure reliability, determine both the number of subjects to be run and the number of trials per subject.


IDENTIFICATION OF HUMAN FUNCTIONS
SYSTEM INDEX
MISSION CHARTS
SYSTEM PERFORMANCE ISSUES
HUMAN PERFORMANCE FUNCTIONS
SYSTEM DEVELOPMENT STAGE
EVALUATION OF SYSTEM DESIGN
EARLY (PRE-PROTOTYPE)
TIMELY INCORPORATION OF HFE INTO SYSTEM DESIGN
EFFECT OF SYSTEM DESIGN ON TRAINING
EFFECT OF SYSTEM DESIGN ON MANPOWER REQUIREMENTS
EFFECT OF SYSTEM DESIGN ON LOGISTICS REQUIREMENTS
TIMELY DEVELOPMENT OF OT TRAINING PACKAGE
SIMILARITY OF OT TRAINING TO FULL SCALE TRAINING
EVALUATION OF SYSTEM/HUMAN PERFORMANCE
LATE (PROTOTYPE EXISTS)
HUMAN PERFORMANCE MEASURES
TEST CONDITIONS
HUMAN RESOURCES IMPLICATIONS AND MEASURES
OPERATIONAL TEST
EVALUATION OF OT RESULTS
DIAGNOSIS OF PERFORMANCE INADEQUACIES

TEST CONDITIONS

This section will help you to select the conditions under which you should measure performance. Notice that the conditions can apply to the System Performance Issues, as well as to the test measures themselves.

NEXT: Turn to Human Resources Implications and Measures (page I-28).

CONDITION CHART

The conditions, in the following ten condition classes, are those which might negatively impact the operation of the system to be tested. It is assumed that best case conditions will be tested in the OT. To insure that probable and operationally significant worst case conditions are tested, apply the Condition Ranking Scales to the appropriate conditions on this Chart.

CONDITION CLASS	CONDITION
Weather	Clouds/Low Ceiling
	Rain
	Fog
	Snow
	Sleet
	Head Wind
	Cross Wind
	Tail Wind
	Continuous High Wind
	Gusts
	High Temperature/Low Humidity
	High Temperature/High Humidity
	Low Temperature/Low Humidity
	Low Temperature/High Humidity
Light	Ambient Light/Dark Variation (Natural Light)
	Flares and Other Artificial Light
	Direct Glare (Natural Light)
	Direct Glare (Artificial Light)
	Reflected Glare from:
	Water
	Ice
	Snow
	Sand
	Clouds/Fog
Ground Surface	Sandy
	Rocky
	Vegetation Covered
	Muddy
	Loam Soil
	Steppe
	Frozen
	Ice Covered
	Snow Covered
	Water Covered
	Broken Ground
	Plowed Fields

CONDITION CLASS	CONDITION
Ground Slope	Flat Hilly (Positive/Negative Slopes) Mountains (Positive/Negative Slopes)
Obstacles/Concealment	Dense Forest/Jungle Hedgerows Dense Brush Sparse Vegetation Water Obstacles/Concealment Natural Rock Holes/Ditches/Trenches Dense Buildings/Walls Bridges Tunnels Manmade Obstacles
Target	Range Size Figure-Ground Contrast/Color Sound Speed Direction Altitude Maneuver Nature of Required Hit (Placement/Type/Number)
Operational	Smoke Concealed Buttoned Up 100% Loaded Damaged Reduced Personnel
Personnel	With low but acceptable aptitude With low but acceptable demonstrated ability With minimum acceptable characteristics of size and strength Extended periods of work without rest (continuous combatfatiqued) Wearing clothing and/or gear (e.g., winter gear, NBC protective equipment)

CONDITION CLASS	CONDITION
Training	Following a period of time without training or practice Trained according to: School Training OJT Unit Training With little or not field experience with this system With little or no field experience with any system in this generic class Crew member not specifically trained for that job

Tactical:

Army systems are exercised according to the tactical theories prevalent at a given time. Tactics change, but the parameters which they control remain relatively constant. The tactical conditions to be exercised in OT will either be the complete tactic or that sement of the tactic which is most significant for the system under investigation. The following parameters of tactics should be treated in the same manner as conditions and be subjected to the Condition Ranking Scales. The resultant ranking should aid in determining which tactics and tactic segments to deal with in OT.

Movement in Attack
Movement in Defense
Movement in Travel
Utilization of Terrain/Weather/Light
Target/Target Part Selection
Weapon/Ammunition Selection
Range Selection
Time to Fire
Unit Size
Unit Composition
Unit(s) Formation
Unit Coordination
Inter-unit Coordination
Length of Continuous Combat

CONDITION CRITICALITY RANKING SCALES

To rank the relative criticality of conditions within each condition class, each should be rated according to the following parameters. Assign the numbers zero to six to each parameter, as indicated.

---

1. What is the probability that the system will operate in this condition <u>for some period of time</u> during the sort of operation in which it is expected to take part?	0 = Probability of the system operating in this condition approaches zero 1 2 3 = Probability of some operating in this condition is about 50% 4 5 6 = Probability of the system operating in this condition at some time approaches 100%
2. To what extent was this system, or a major component of this system, specifically designed to operate in this condition?	0 = System/components not designed for this condition 1 2 3 = Design takes this condition into account 4 5 6 = Reason for the design of this system/component is the ability to operate in this specific condition
3. To what extent does this condition have a history of being associated with inadequate performance and other problems in similar systems of this generic class?	0 = No history of problems 1 2 3 = History of a number of nonsevere problems 4 5 6 = History of severe problems and/or frequent problems

4. To what extent does this condition have a history of being associated with inadequate performance and other problems in the system in question during prior OT's and/or DT's?

0 = No history of problems
1
2
3 = History of a number of non-severe problems
4
5
6 = History of severe problems and/or frequent problems

5. To what extent will this condition place unusual demand or stress on the operator and/or system?

0 = No unusual demands/stress
1
2
3 = Average amount of demands/stress
4
5
6 = High level of demands/stress

CONDITION DIFFICULTY RANKING SCALES

To determine the difficulty of performing an HPF under a specific condition, it is necessary to evaluate the difficulties of the condition present in the input, decision making and output components of the HPF. These component difficulties sum to an overall difficulty evaluation for that condition. Assign the numbers zero to six to each of the following parameters, as indicated.

1. To what extent does this condition increase the difficulty of perception of the external-system environment for this HPF?

   0 = Presents no additional difficulty
   1
   2
   3 = Somewhat more difficult
   4
   5
   6 = Very much more difficult

2. To what extent does this condition increase the difficulty of the internal system environment, including its displays and controls, for this HPF?

   0 = Presents no additional difficulty
   1
   2
   3 = Somewhat more difficult
   4
   5
   6 = Very much more difficult

3. To what extent does this condition increase the difficulty of decision making for this HPF?

   0 = Presents no additional difficulty
   1
   2
   3 = Somewhat more difficult
   4
   5
   6 = Very much more difficult

4. To what extent does this condition increase the difficulty of control of motor responses for this HPF

   0 = Presents no additional difficulty
   1
   2
   3 = Somewhat more difficult
   4
   5
   6 = Very much more difficult

5. To what extent does this condition increase the difficulty of multiple demands in this HPF? (Multiple demands, in this context, relate to time sharing of perception, decision making and motor responding.)

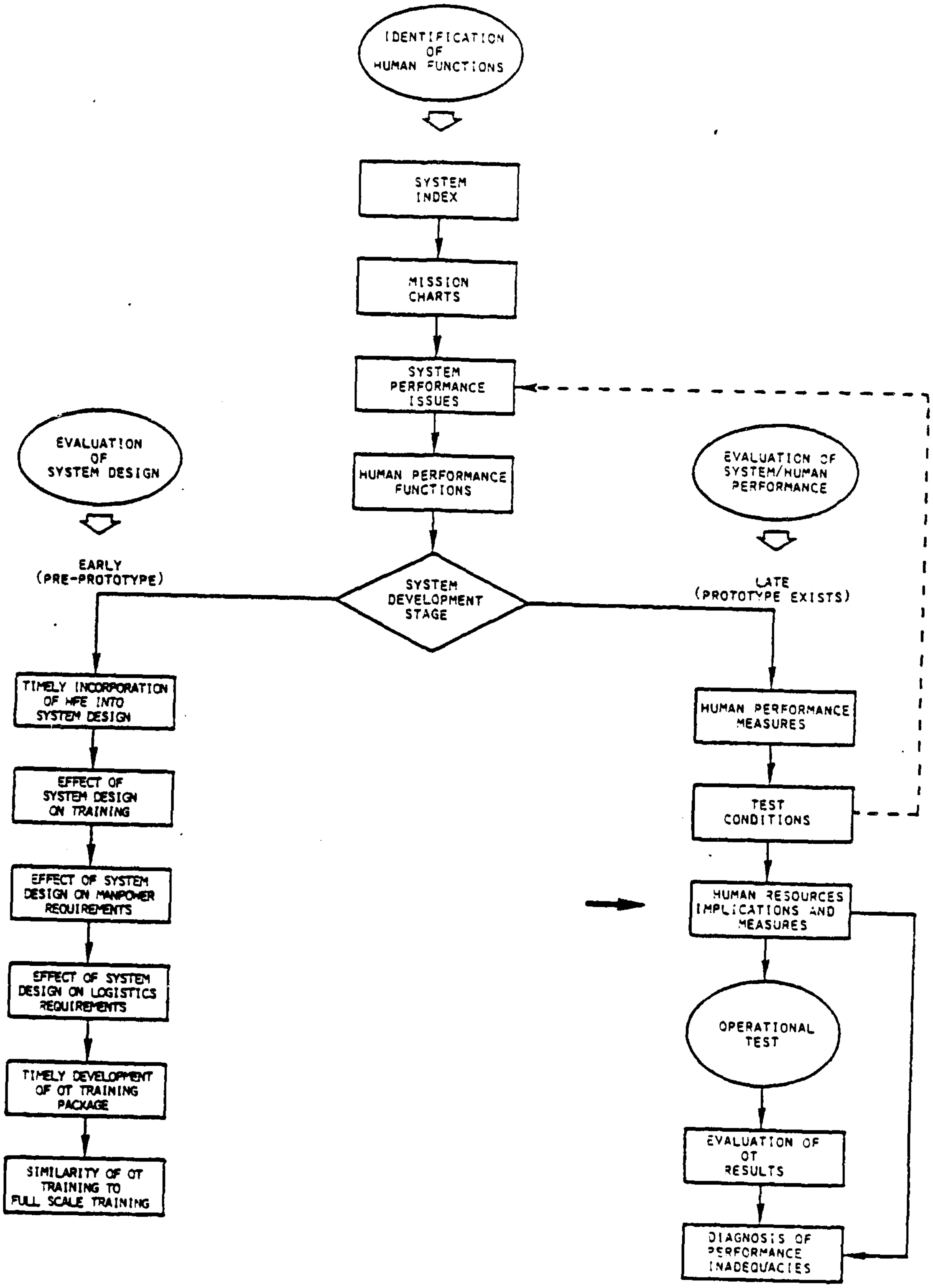
0 = Presents no additional difficulty
1
2
3 = Somewhat more difficult
4
5
6 = Very much more difficult

WORKSHEET

RELATIONSHIP BETWEEN CONDITION
CRITICALITY-DIFFICULTY AND TRAINING TIME

Conditions

CRITICALITY PARAMETERS	1												
	2												
	3												
	4												
	5												
	6												
	SUM												
DIFFICULTY PARAMETERS	1												
	2												
	3												
	4												
	5												
	SUM												
PRODUCT OF SUMS													
PRODUCT RANKED OF SUMS													
TRAINING TIME													
RANKED TRAINING TIME													


IDENTIFICATION OF HUMAN FUNCTIONS
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HUMAN RESOURCES IMPLICATIONS AND MEASURES

Human Resource Implications are those questions which you ask to aid in determining the causes(s) of operator/maintainer sub-criterion performance. Human Resource Measures are a means of answering the Human Resource Implications. The measures of Human Resource Implications can be taken before, during, or after the OT exercise. While the OT is in its planning stage, you should determine when each measure should be taken. This section includes a procedure designed to aid you in making this determination.

During OT planning, first read the allocation procedure on page I-29. Next, read the Human Resources Implications and associated Measures on pages I-32-I-54 and apply the allocation procedure to them. Include these allocated Measures in your Test Plan. If you discover that you have left out important Human Resource Measures, immediately following the OT exercise read through these Measures again and select appropriate ones which you can still take.

PROCEDURE FOR DETERMINING
WHICH HUMAN RESOURCE ISSUES
TO TEST BEFORE OR DURING OT

STEP 1: List all the human performance functions (HPF) you are going to test in OT on the rows of the Human Resource Issue Work Sheet Table 1 (page I-30). Make additional copies of the worksheet if necessary.

STEP 2: Rate each HPF on each of the four rating items listed on page Place the items' rating in the appropriate place of Table 1 (page I-30).

STEP 3: Sum the ratings for the four items for each HPF and enter the value in the appropriate space in Table 1.

STEP 4: Rate each human resource area listed in Table 2 (page I-31) on each of the three rating items shown on page

STEP 5: Sum the ratings for the three items for each human resource area and enter the value in the appropriate space in Table 2.

STEP 6: Transfer the sum values from Tables 1 and 2 to the margins of Table 3 (page I-32).

STEP 7: Multiple the marginal values in Table 3 to obtain a product for each cell in the task.

STEP 8: The cells with the highest values should be considered for measurement before or during OT.

HUMAN RESOURCE ISSUE WORK SHEET

TABLE 1

	Items from Page				
Human Performance Functions	1	2	3	4	Sum 1 to 4

TABLE 2

Human Resource Items	Items from Page 1	2	3	Sum 1 to 3
Training				
Human Engineering				
Manpower Planning				
Logistics				

TABLE 3

Human Performance Functions	SUM ITEMS 1-3 (Table 1)	Human Resource Areas: Training	HFE	Manpower	Logistics
	SUM ITEMS 1-3 (Table 2)				

RATING ITEMS FOR HUMAN PERFORMANCE FUNCTIONS

1. To what extent does the system involve a modification of improvements which could impact this HPF.

2. To what extent have similar existing systems, or prior OT or DT activities, demonstrated problems with this HPF.

3. To what extent is it anticipated that this HPF will not be successfully performed during OT.

4. To what extent will performance of this HPF be evaluated during OT.

RATING ITEMS FOR HUMAN RESOURCE AREAS

1. To what extent have similar existing systems or prior OT or DT activities demonstrated problems with this human resource area.

2. To what extent are the human resource measures associated with this area obtainable after the OT exercise has been completed.

3. What is the cost and/or feasibility of obtaining the measures associated with this human resource area before or during OT relative to the cost/feasibility of obtaining them after OT.

HUMAN RESOURCE ISSUES

- TRAINING -

The following measures apply to those Human Performance Functions (HPF) for which performance has been sub-criterion.

FOR THE HPF WHICH IS AT A SUB-CRITERION PERFORMANCE LEVEL APPLY THE FOLLOWING ISSUES:

1. To what extent has adequate time been spent in training on this HPF?

   1.1 <u>Relationship between relative HPF criticality-difficulty and relative percentage of time spent in training</u>. (See procedure for Diagnostic Measure #1, page I-41.)

   The relative amount of time spent in training should match the relative criticality-difficulty of the HPF. This measure is an attempt to determine if an adequate amount of training time was spent on the HPF in question. If, in relation to other HPF's, less time was spent training an HPF than its criticality-difficulty indicates, and if that HPF did not reach criterion performance level, then one may infer that insufficient time was spent on it.

2. How well did students perform this HPF in training?

   2.1 <u>Mean exit score</u>

   Exit scores are those numerical ratings which are assigned to each student for a given HPF as a result of OT training. OT students should have been trained on selected, critical HPF's to

predetermined levels of performance. They should have been given tests which, when performed at or above the predetermined performance levels, permitted exit from that particular part of the training. Exit scores must be kept as raw scores, that is, not converted into pass-fail. All exit scores must be recorded for this measure, regardless of the students' passing or failing. If the students do better than the predetermined exit criteria, this must be noted and not collapsed into a homogeneous pass score. Exit scores should equal or exceed OT HPF criteria for successful field performance.

2.2 Trainers' ratings of student ability

It is assumed that student ability has a significant impact on training effectiveness in OT. It is also assumed that exit scores, though important, do not also permit sufficient latitude for an understanding of the students' level of ability in OT. For this reason, a form is provided to aid trainers in the assessment of student ability. Since the OT training package trains personnel who come into the OT with individual ability levels, an understanding of training effects necessitates an understanding of pre and post training student ability. The appropriate form may be found on page .

2.3 Mean number of exit trials to reach exit criterion in training

It is assumed that all students, in the OT training package, may not be able to reach HPF performance exit level on their first attempt. The mean number of exit trials required to reach exit criterion provides further information about both the effectiveness of the training and the ability level of the students.

2.4 Number of individuals who failed to reach exit level criterion

It is possible that, within the specified number of exit trials permitted, some students may not be able to reach the required level. The number and consequent percentage of such students will provide further data to aid in the determination of the effects of training on OT performance. If a large number of students fail, it may indicate a potential difficulty with the HPF.

3. To what extent were applicable training methods used to train this HPF?

3.1 Compatibility of training method to skill being trained

The skills required for the performance of HPF's may be trained by a number of different methods. The nature of the skills ought to determine which of the training methods is used. Sub-criterion performance in the OT may be related to inappropriate training method used. The compatibility between training method and skill may be viewed as affecting OT performance in the following manner. The less compatible these are, the greater the likelihood of ineffective learning and consequent inadequate performance. For the procedure to determine this compatibility, see pages I-48-I-50.

4. How effective were the trainers in OT training?

4.1 Applicable training experience of trainers in months

There are certain assumptions one makes when assessing the effectiveness of trainers. One of these assumptions is that more training experience should increase the effectiveness of training. Knowing the amount of applicable training

experience that a trainer has had may serve as an aid in explaining student OT performance.

4.2 Operator/maintainer experience or training on current or similar systems (in hours or months, as applicable)

It is recognized that individuals who are not highly proficient at a particular skill may still be able to train others effectively on that skill. In general, however, it is assumed that there is some positive relationship between trainer operational ability and ability to train a skill effectively.

4.3 MOS skill level of trainer in applicable specialty

This measure may be viewed as a subset of 4.2. It is taken for much the same reason.

4.4 Student ratings of trainers' abilities

Student ratings of trainers serve two possible functions:

(1) They can provide information about the trainers' abilities, which leads to a greater understanding of the effects of training on OT.

(2) They can serve as an index of the students' attitudes toward their trainers, and this itself may have a significant bearing on the effect of the training package. A student rating form may be found on page .

5. What is the relationship between conditions applied in OT training and OT exercises?

5.1 Similarity of conditions applied in training to conditions encountered in OT exercises

One of the goals of training is to prepare students for the conditions they are likely to encounter in the operational environment. If students, who otherwise pass satisfactorily through an OT training course, find it impossible to reach criterion levels in the field exercises of the OT, one may discover that they could not make the transition from training conditions to field conditions. For this reason, it is desirable to determine the similarity between those conditions which were applied in OT training and the conditions actually seen in the OT exercises. The greater the disimilarity between those two sets of conditions, the more likely training is to be a cause of sub-criterion performance in OT. Procedures for obtaining this measure may be found on page I-51.

6. How effective was the organization and learning environment in OT training?

6.1 Student evaluation of training experience

As in 4.4, student ratings of the training experienc serve two possible funtions:

(1) They can provide information about the training package, in general, which may not be available through more standardized quantifiable means. This information will tend to lead to a greater understanding of the effects of training on OT.

(2) They can serve as an indication of students' attitudes toward the OT training. These attitudes, whether valid or not, will influence the effect of the OT training package on the students and, therefore, provide further information on the reasons for sub-criterion OT performance. A student rating form can be found on page I-43.

6.2 Trainers' evaluation of the OT training experience

(1) They can provide information about the training package, in general, which may not be available through more standardization quantifiable means. This information will tend to lead to a greater understanding of the effects of training on OT.

(2) They can serve as an indication of trainers' attitudes toward the OT training. These attitudes, whether valid or not, will influence the effect of the OT training package on the trainers and, therefore, provide further information on the reasons for sub-criterion OT performance. A trainer rating form can be found on page .

PROCEDURE FOR DIAGNOSTIC MEASURE #1

(Relationship between relative HPF criticality-difficulty and relative percent time spent in training).

Step 1. Determine the criticality for each HPF involved in OT training (regardless of whether performance in OT was sub-criterion).

1.1 Rate each HPF on each item of the criticality rating form contained on page .

1.2 Write the individual criticality ratings on the worksheet contained on page . (Photocopy a sufficient number of worksheets to accommodate all HPF's to be evaluated).

1.3 Total the ratings for each HPF and enter the values in the appropriate spaces on the worksheet.

Step 2. Determine the difficulty for each HPF involved in OT training (regardless of whether performance in OT was sub-criterion).

2.1 Rate each HPF on each item of the difficulty rating form contained on page I-47.

2.2 Write the individual difficulty ratings on the worksheet contained on page I-47

2.3 Total the ratings for each HPF and enter the values in the appropriate spaces on the worksheet.

Step 3. For each HPF, multiply the criticality sum by the difficulty sum to obtain the product of sums; then enter the values in the appropriate spaces on the worksheets.

Step 4. Rank the product of sums, using "1" for the highest product; this is the most critical/difficult HPF.

Step 5. Obtain from the OT training personnel the mean amount of training time spent on each HPF.

Step 6. Enter the training time for each HPF in the appropriate place on the worksheet.

Step 7. Rank the training times, using "1" for the most time.

Step 8. Compare the ranked product of sums with the ranked training time.

8.1 If the ranked product of sums is larger or equal to the ranked training time, then one may conclude that adequate training time was given on this HPF.

8.2 If the ranked product of sums is smaller than the ranked training time, then one may conclude that insufficient training time may have been given on this HPF.

HPF CRITICALITY RATING FORM

To compute the criticality of HPF's for training, each should be rated according to the following parameters. Assign the numbers zero to six to each of the following parameters, as indicated.

1. To what extent is this system, or a component of this system, specifically designed to carry out the HPF.	0 = Not designed specifically for HPF 1 2 3 = Design takes the HPF into account but is not specifically designed for it 4 5 6 = Principle reason for the design of this system is the performance of this specific HPF.
2. In relation to other HPF's how often is it performed in this system?	0 = Seldom if ever 1 2 3 = About as often as any other 4 5 6 = This system will only perform this HPF.
3. What would be the effect of failure to successfully complete this HPF on survivability of the system/ operator?	0 = No effect 1 2 3 = Medium probability of destruction 4 5 6 = High probability of destruction or surrender of system

4. To what extent have other systems in this generic class had a history of inadequate performance or encountered problems in carrying out this HPF.

0 = No history of problems
1
2
3 = Has encountered a number of severe problems
4
5
6 = History of severe problems and/or frequent problems

5. To what extent have prior DT's/OT's indicated problems in successfully performing this HPF.

0 = No history of problems
1
2
3 = Has encountered a number of severe problems
4
5
6 = History of severe problems and/or frequent problems

6. What would be the effect of failure to perform this HPF on the effectiveness of the system's mission?

0 = No effect
1
2
3 = Mission significantly impaired but not a complete failure
4
5
6 = High probability of total mission failure

HPF DIFFICULTY RATING FORM

To determine the difficulty of an HPF, it is necessary to evaluate the difficulties of its input, decision making and output components. These component difficulties then sum to an overall difficulty evaluation. Assign the numbers zero to six to each of the following parameters, as indicated.

1. To what extent is perception of the external-system environment a source of difficulty to this HPF? Factors contributing to this difficulty include:

   0 = Presents no difficulty
   1
   2
   3 = Somewhat difficult
   4
   5
   6 = Very difficult

   (a) vibration

   (b) inadequate illumination

   (c) inadequate visual access

   (d) too much noise

   (e) many inputs to attend to

2. To what extent is perception of the internal system environment, including its displays and controls, a source of difficulty in this HPF? Contributing factors include:

   0 = Presents no difficulty
   1
   2
   3 = Somewhat difficult
   4
   5
   6 = Very difficult

   (a) vibration

   (b) inadequate illumination

   (c) poorly designed on placed displays/controls

   (d) inadequate visual access

   (e) many inputs to attend to

   (f) too much noise

3. To what extent is decision making a source of difficulty in this HPF? Contributing factors include:

   (a) large number of decision points

   (b) many alternatives per decision

   (c) lack of formal decision rules

   (d) tight time constraints

   (e) important consequences

0 = Presents no difficulty
1
2
3 = Somewhat difficult
4
5
6 = Very difficult

4. To what extent is the control of motor responses a source of difficulty in this HPF? Contributing factors include:

   (a) vibration

   (b) improper design of a control

   (c) poor position of control

   (d) short time constraints

   (e) close tolerences required

   (f) large amount of strength required

   (g) many responses required

0 = Presents no difficulty
1
2
3 = Somewhat difficult
4
5
6 = Very difficult

5. To what extent are multiple demands inherent in this HPF a source of difficulty? Multiple demands in this context relate to time sharing of perception, decision making and motor responding.

0 = Presents no difficulty
1
2
3 = Somewhat difficult
4
5
6 = Very difficult

WORKSHEET

RELATIONSHIP BETWEEN HPF CRITICALITY-DIFFICULTY AND TRAINING TIME

		HPF											
CRITICALITY PARAMETERS	1												
	2												
	3												
	4												
	5												
	6												
	SUM												
DIFFICULTY PARAMETERS	1												
	2												
	3												
	4												
	5												
	SUM												
PRODUCT OF SUMS													
PRODUCT RANKED OF SUMS													
TRAINING TIME													
RANKED TRAINING TIME													

DIAGNOSTIC TRAINING MEASURE #3
COMPATIBILITY OF SKILL AND TRAINING METHOD

Step 1. Enter percent of time spent training this HPF in each modality listed below:

Modality	% Time Spent in Training
1. Classroom-lecture	________
2. Audio-visual presentation	________
3. Paper Pencil Test	________
4. Hands-on simulation	________
5. Field Experience	________
6. Observation of other students.	________

Step 2. Compute a time index for each of the ______ skills listed below using the equations given.

where $\%M_1$ = % of time spent in training this HPF using modality 1 (classroom-lecture)

$\%M_2$ = % of time spent in training this HPF using modality 2 (audio-visual presentation)

and so-on for each modality listed in Step 2.

Skill 1 (Visual Discrimination) Index =

$(\%M_1 \times 1.1) + (\%M_2 \times 5.8) + (\%M_3 \times 4.0)$
$+ (\%M_4 \times 3.0) + (\%M_5 \times 2.8) \ldots.$

Skill 2 (Fine hand motor control) Index =

$(\%M_1 \times .1) + (\%M_2 \times .2) + (\%M_3 \times .1)$
$+ (\%M_4 \times 6.4) + (\%M_5 \times 6.8) + \ldots.$

Skill 3 (Team Coordinator) Index =

.

.

.

Skill N (   ) Index =

Step 3. Enter the percent of HPF performance that involves each of the skills listed below.

Skill	% of HPF Performance Involving the Skill
1. Visual	
2. Fine hand motor control	
3. Team Coordinator	
.	
.	
.	
N	

Step 4. Rank the skill time indices (computer in Step 2) from lowest (Rank = 1) to highest (rank = N) and enter them on the chart below.

Rank the % of HPF performance involving each skill (computed in Step 3) from lowest (rank - 1) to highest (rank = N) and enter on the chart below.

Skill	Skill Time Index Rank	% HPF Performance Rank
1. Visual Discrimination		________
2. Fine hand motor control		________
3. Team Coordinator		________
.		
.		
.		
N		

Step 5. Compute the degree of concordance between the two sets of ranks in Step 4. The higher the value, the better the compatibility of skills and modalities used to train this HPF.

TRAINING DIAGNOSTIC MEASURE #5

CONDITIONS IN OT TRAINING AND OT EXERCISE

Step 1. List the condition(s) under which performance on this HPF failed in the operational test

Condition in OT
1. ________
2. ________
3. ________
4. ________

Step 2. Determine the percentage of time this HPF was practiced in each condition identified in Step 1.

	Condition (from Step 1)	% Time Practiced in Training
1.	________	________
2.	________	________
3.	________	________
4.	________	________

Step 3. Was there any condition under which no practice on this HPF took place in training (that is, are there any zero percentages listed in Step 2)?

If the answer is ______ then:

Yes	may indicate that HPF performance was suboptimal because no practice was given under this condition in OT training.
No	Continue with Step 4.

Step 4. Compute the criticality of each condition using the HPF condition criticality rating form on page . Enter the values below.

Condition (from Step 1)	Rating Form Rating Form Items						Sum
	1	2	3	4	5	6	1 to 6
1. ______	_	_	_	_	_	_	______
2. ______	_	_	_	_	_	_	______
3. ______	_	_	_	_	_	_	______

Step 5. Compute the difficulty of each condition using the HPF condition difficult rating form on page . Enter the values below.

Condition (from Step 1)	Rating Form Rating Form Items					Sum
	1	2	3	4	5	1 to 5
1. ______	_	_	_	_	_	______
2. ______	_	_	_	_	_	______
3. ______	_	_	_	_	_	______

Step 6. Compute for each condition, a single criticality-difficult index by multiplying the criticality and difficulty ratings from Steps 4 and 5. Rank these giving a rank of 1 to the lowest product.

Condition (from Step 1)	Step 4 Sum 1-6	x	Step 5 Sum 1-5	=	Product	Rank
1. ______	______		______		______	___
2. ______	______		______		______	___
3. ______	______		______		______	___

Step 7. Rank the percentage time values in Step 2 and compute the design of concordance between these ranks and those computed in Step 6.

	Condition	Percentage Time Ranks	Ranks From Step 6
1.	______	______	______
2.	______	______	______
3.	______	______	______

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